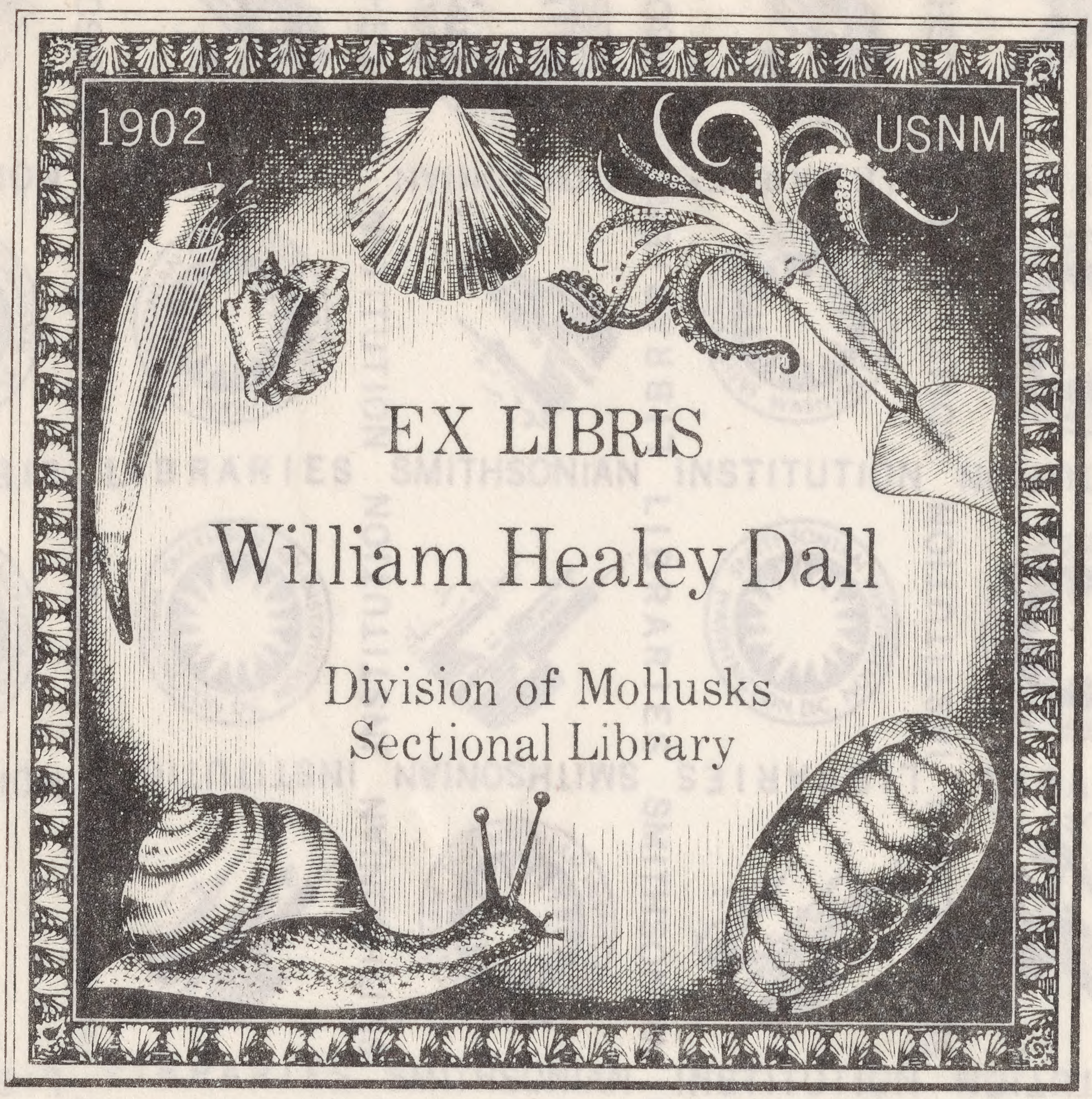

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THE

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(Founded 1874)

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OF
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EDITED, UNDER THE DIRECTION OF THE COUNCIL,

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PLATES

PLATE FACING PAGE
1 Spat collector. Anchoring collector 32
2 Fixation of spat. Prototype nursery
3 Prototype growing tray. One day's harvest
4 Culvert, Brighton Power Station. Fouling
5 Charles John Gabriel 75
6 Fossil *Helix hortensis* in Orkney 136
7 *Littorina urieli* Biggs. *L. novaezealandiae* Reeve 138
8 *Milax budapestensis*, faecal pellets and eggs 144
9 *Unio castelli* Woodward 200
10 James Henry Lumb 201
11 Robert Rendall 274
12 Hamilton Ernest Quick 275
13 *Pterynotus annandalei, P. triqueter* & *Chicoreus consulae* 304
14 Scalariformity in *Helix aspersa* 332
15 T. G. W. Fowler 333
16 *Anodonta cygnea* with chironomid larva 382

(Plates 1 – 4 between pages 32 and 33)

ollusks

Vol. 26 MARCH 1966 No. 1

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OF GREAT BRITAIN AND IRELAND

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CONTENTS

PAGE
Editorial 1
M. P. Kerney—Snails and Man in Britain 3
W. O. Cernohorsky—Radulae of four species of Mitridae (Mollusca: Gastropoda) . 15
St[illegible] M. Turk—The rediscovery of *Theba pisana* (Müller) in Cornwall . . 19
William Reed—Cultivation of the black-lip pearl oyster *Pinctada margaritifera* (L.) . 26
D. S. Davis & W. R. White—Molluscs from a power station culvert . . . 33
W. S. S. van Benthem Jutting—Two new species of *Hydrocena* (Neritacea) from Sabah, Borneo 39
J. G. J. Kuiper—The status of *Pisidium hibernicum* Westerlund 42
N. F. McMillan—*Arianta arbustorum* (L.) living with *Helix nemoralis* L. on blown sand . 47
A. C. van Bruggen—*Physa acuta*, an introduced species new to South Africa . . 49
A. W. Stelfox & N. F. McMillan—The distribution in Ireland of very dark forms of *Cochlicella acuta* (Müller) 51
H. E. J. Biggs & Christopher Wilkinson—Marine Mollusca from Malta . . 52
H. E. J. Biggs—Report on Junior Membership for 1964 (First Year) . . . 65
F. A. Schilder—*Mauritia mauritiana* (L.) at Aden 66
N. F. McMillan—*Margaritifera margaritifera* (L.) in hard water in Scotland . . 69
B. Verdcourt—The type-species of *Marconia* Bourguignat (Streptaxidae): a correction . 71
B. Verdcourt—Comments on T. E. Crowley's paper on *Aspatharia bourguignati* (Bourguignat) 73
David Heppell—Obituary. Charles John Gabriel, 1879–1963 75
Reviews 68, 72, 74
Proceedings: 20 February 1965 (Annual General Meeting), 13 March 1965, 10 April 1965, 15 May 1965 76
Plates 1–5

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EDITORIAL

When J. W. TAYLOR, the founder and first Editor of our Journal, retired from the Editorship in 1894, he referred to the Journal's progress in the following words:

> The Journal was originally commenced as the "Quarterly Journal of Conchology" in February 1874, at a time when the science of Conchology was at a very low ebb in Britain, its students few, scattered, and disorganized, and as a necessary consequence the publication of the work was for years after its inception only carried on by steady sacrifices of time and money. Such sacrifices as were necessary I however cheerfully made, and the publication was persevered with in spite of manifold discouragements and against the advice of many kind and true friends, who looked upon a financial return as the crucial test for all projects, scientific or otherwise. In process of time, however, the exertions and sacrifices I made begun to take effect, more and more interest was taken in the study, and the students and subscribers increased in numbers. . . . The "Journal of Conchology" having survived all the dangers of its early life, now occupies a firm and assured position.

Today, at the end of 1965, with twenty-five volumes completed, it seems opportune briefly to review the subsequent progress of the Journal up to date and to look to the future.

The Conchological Society had adopted the *Quarterly Journal of Conchology* as its organ in 1878 and arrangements had been made in 1889, by which time the title had been shortened to *Journal of Conchology*, for copies to be issued to all Members. This arrangement continued until the close of 1894 when the Society purchased the goodwill, copyright and the stock of back numbers from TAYLOR for £30, to be paid in three instalments. Even with the low printing costs of those days this sum was not readily available and it was not until 1900 that the final instalment was paid, after an appeal by the Treasurer had raised £41 13s. 6d. in special donations. The Journal, now the sole property of the Society and issued under the direction of its Council and the Editorship of W. E. HOYLE, continued to flourish and membership of the Society grew steadily. In the early years of the Journal, a number of the papers included had been reprinted from elsewhere and the rest were concerned predominantly with British non-marine molluscs. But as the membership increased so the papers submitted embraced an ever greater range of interests, and in 1897 it was decided to alter the format of the Journal to accommodate a larger amount

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of text: the margins and the spacing between the lines were reduced and a slightly smaller size of type was used, thus obtaining an enlargement of some 25%.

HOYLE resigned from the Editorship in 1907 and was succeeded by J. R. LE B. TOMLIN who held that office for over forty years until 1948 when he in turn was succeeded by A. E. ELLIS who held office until last year. It must surely be something of a record for a Journal a little over eight years away from its centenary to have experienced only five Editors, and this may account for the maintenance of a high degree of uniformity in the Journal over much of that period. Quarterly publication was maintained until the end of 1917 when the cost of paper and printing, which had increased as a result of the war, necessitated a reduction to three issues a year. In 1919 and 1920 only two numbers were issued, and then tri-annual publication was resumed until the end of 1939 after which rising costs rendered a further reduction inevitable.

In recent years considerable space has been saved by the gathering together of new British distributional records into the annual Recorder's report and, since 1961, the Newsletter has provided an alternative channel for the rapid and inexpensive publication of many short notes and articles of general interest. Nevertheless the number of papers accepted for publication in the Journal continues to increase, as the thickness of some recent issues will testify and, accordingly, it was decided that volume 25 should be brought to a close with number 8 and that volume 26 and subsequent volumes should be issued in a new format with a larger area available for text and illustrations. It is hoped that a comprehensive index to volumes 1–25 can be produced if there is sufficient demand. Negotiations are in progress for the facsimile reprinting of the now out-of-print 1951 Census number, with a supplement by Dr M. P. KERNEY to bring it up to date, and other out-of-print back numbers may also be reprinted subject to demand.

An apology is tendered to Members and Subscribers for the delay in the publication of volume 25 number 8. This was due to a variety of reasons, some of which were beyond the Editor's control. It is expected that the publication of the Journal will be more regular in the future. I cannot conclude without a tribute to Mr A. E. ELLIS for his conduct of the Journal during the sixteen years of his Editorship. Inevitably, for geographical reasons, the Journal provides for many Members their only contact with the Society. The growth in membership from 150 to 320 during those sixteen years must, therefore, reflect the increased esteem afforded the Journal, for which Mr ELLIS is in no small way responsible. To this I add my personal thanks for his generous advice and encouragement with which endowed I follow in the distinguished footsteps of TAYLOR, HOYLE, TOMLIN and ELLIS a little less dauntedly.

THE EDITOR

J. Conch. **26**: 3–14. (1966)

SNAILS AND MAN IN BRITAIN

M. P. Kerney
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(*Presidential Address, delivered* 20 *February* 1965)

Human interference in the landscape of Britain is of great antiquity. Very little of what we see even in remote or 'wild' areas is at all as it was prior to the advent of man. Indeed, with the exception of sea cliffs, coastal dunes, the higher mountains, a few bogs and marshes, and some small patches of modified woodland, it is doubtful if any of our landscape can be called natural. The greater part of the British Isles was formerly covered by forest which, from Neolithic times onwards, was gradually cleared for purposes of grazing or cultivation. With agriculture came the creation of farmsteads, the making of hedges, walls and roads, the embanking of rivers and the drainage of marshes. Clearly all this had an immense effect on animal and plant communities. Tansley (1939) gives an excellent account of the disturbed nature of our present vegetation, and much is now known of the detailed history of botanical change from pollen analysis of deposits which formed in the vicinity of human settlements during the last 5,000 years (Godwin, 1956). In this talk I want to say something of the effects of man on the land and freshwater Mollusca. To do so it will first be necessary to discuss briefly the origin of our fauna, and to describe its probable composition at the time when the first Neolithic farmers settled in southern England.

ORIGIN OF THE INDIGENOUS FAUNA

During the Last (Würm, or Weichsel) Glaciation, ice sheets covered the northern two-thirds of the British Isles. There can be no doubt that the greater part of the rich molluscan fauna which lived here in the Last Interglacial (Sparks, 1964) was exterminated. Probably, however, a few of the more hardy species were able to withstand the extremely cold climate existing in the periglacial zone in the south, and we may suppose that among them were *Lymnaea truncatula* (Müller), *L. peregra* (Müller), *Planorbis laevis* Alder, certain *Pisidium* and *Succinea* species and, perhaps, *Pupilla muscorum* (L.). At least two boreal-alpine species, *Columella columella* (Benz) and *Vertigo genesii* Gredler, occurred also. Unfortunately, we have as yet little direct knowledge of the Mollusca existing during the coldest phases of the Last Glaciation, most of the scanty fossil evidence coming from deposits which appear to represent temporary climatic ameliorations (COOPE *et al.*, 1961; KENNARD & WOODWARD in WARREN, 1912).

It has frequently been suggested that certain elements in the British fauna and flora, most notably a number of species with 'Lusitanian' distributions in Europe, represent survivals *in situ* from a 'pre-glacial' period. Among the molluscs, *Testacella maugei* Férussac, *Theba pisana* (Müller), *Hygromia subvirescens* (Bellamy) and *Geomalacus maculosus* Allman have been placed in this group, but our present knowledge of climatic conditions in Britain during the Last Glaciation makes this hypothesis very difficult to accept, even if we assume refuges on now submerged areas of the continental shelf somewhat to the south-west of Ireland and Cornwall. It is much more likely that these species arrived during the Post-glacial Period by migration from the south along a once continuous coastline. In the case of *Testacella maugei* and *Theba pisana*, it is alternatively possible that man has been responsible for their introduction to Britain in comparatively recent times.

Towards the end of the Last Glaciation, in the so-called Late-glacial Period (*c.* 15,000–8,300 B.C.), the climate became milder. It was then that the foundation of our present fauna was laid. Because of a low, glacial sea-level, Britain was still united to the continent, and rapid migration took place from the south, particularly during the warmer interval known as the Allerød Oscillation (10,000–8,000 B.C.). Most of our hardier freshwater species, with good powers of dispersal, became re-established, as well as about twenty-five land snails, among which were a few moderate thermophiles. Xerophiles of open ground, of the genera *Pupilla*, *Abida*, *Vallonia* and *Helicella*, flourished (KERNEY, 1963) as trees were as yet scanty except in the extreme south.

The Post-glacial Period, or Holocene, is taken as beginning about 8,300 B.C., when temperatures rose sharply and forests of birch and pine spread over large areas of Britain and north-western Europe. Although sea-levels were now rapidly rising, the final submergence of the English Channel was probably not effected until about 5,000 B.C. Until that time additions to our molluscan fauna continued to be made, relatively tolerant species arriving first, and more thermophilous forms later. The details of the process are now well known for the flowering plants, and a similar picture will no doubt emerge for the land and freshwater Mollusca as Holocene deposits yielding them are more carefully studied. For example, it is already apparent that certain species with somewhat northerly

European distributions, such as *Carychium tridentatum* (Risso), *Clausilia bidentata* (Ström) and *Vitrea contracta* (Westerlund), had become common in southern England quite soon after the end of the Last Glaciation, whereas more warmth-loving forms, such as *Acicula fusca* (Montagu), *Azeca goodalli* (Férussac) and *Pomatias elegans* (Müller), seem not to have arrived until late in the Boreal or early in the Atlantic Period, that is after about 6,000 B.C. It is extremely interesting to note that *Azeca* and *Pomatias* are absent from Ireland, the land bridge across the Irish Sea having been submerged at a rather earlier date than that between England and France. We must not, however, expect too close a correlation between climatic tolerance, as inferred from present-day geographical ranges, and order of immigration in response to rising temperatures. Modern distributions depend on factors other than climate, migration rates for different species will vary widely, and those forms which reach a new area first may, in the absence of competition, be able to spread and multiply more effectively than later immigrants adapted to ecologically similar environments.

The Fauna of the Climatic Optimum

Our native fauna of land and freshwater Mollusca was probably complete by about 5,000 B.C., and something must be said about its probable composition. At this time, in the so-called Atlantic Period, the climate had become fully temperate; indeed there is convincing evidence that the mean summer temperatures were of the order of 2°C higher than at the present day. Forest, mainly of oak, alder, elm and lime, but with a certain amount of pine and birch in the north, covered by far the greater part of the country, including much of the chalk downs, the Pennine moors, and the highlands of Scotland. Mollusca adapted to woodland were favoured at the expense of those of grassland. *Pupilla*, *Vallonia* and *Helicella* were exterminated from large areas, finding refuges either on the coast or in scattered inland places which resisted afforestation. At least two grassland species, *Helicella geyeri* (Soós) and *H. striata* (Müller), became extinct. Conversely, many woodland snails now regarded as local then probably possessed almost universal distributions: such are *Acicula fusca*, *Vertigo substriata* (Jeffreys), *Lauria anglica* (Wood) and *Acanthinula lamellata* (Jeffreys). In the south of England *Azeca goodalli*, *Ena montana* (Draparnaud) and *Helicodonta obvoluta* (Müller) were more common then than now.

On the waterlogged flood plains of innumerable rivers and streams, and in the fenlands of East Anglia and elsewhere, the mixed-oak forest was replaced by alder-carr or sedge-fen, where hygrophilous land snails frequently abounded. Much of our knowledge of the land fauna of this time derives from the deposits formed in such places, into which large numbers of shells from the surrounding woodland were carried (KENNARD & MUSHAM, 1937; KENNARD in WARREN, 1945; KERNEY *et al.*, 1964).

THE INFLUENCE OF MAN ON THE INDIGENOUS FAUNA

Although locally rich, the total land snail fauna of Britain in the Atlantic Period was smaller than today, and much more uniform over great areas. At this time man was still a hunter and food-gatherer at the Mesolithic stage of development and his effect on the natural environment was probably as yet negligible. But around 3,000 B.C. small communities of Neolithic farmers reached our shores and settled on limestone uplands or on the dry gravel terraces of certain river valleys. With hafted stone axes they felled patches of the lighter woodland for purposes of sheep farming or cultivation. Grazing, in turn, prevented regeneration of the trees. With the Early Iron Age (*c.* 500 B.C. onwards) vigorous arable farming with wheeled ploughs began, and by the end of the Roman era considerable inroads had been made on the forests of the heavier clay soils. Clearance continued throughout the Middle Ages and was largely completed by about the middle of the sixteenth century (HOSKINS, 1955).

The most obvious if not the most important result of this process has been a very great restriction of the 'woodland' element of our fauna, i.e. of those species whose prime demand is for moisture and shade. Their powers of survival differ considerably. *Acicula fusca*, *Ena montana*, *Helicodonta obvoluta*, *Acanthinula lamellata* and *Limax tenellus* Müller are normally easily exterminated by disturbance of their habitats; *Carychium tridentatum*, *Ena obscura* (Müller), *Marpessa laminata* (Montagu) and *Retinella pura* (Alder) are less so; whilst *Discus rotundatus* (Müller), many of the Zonitidae, and most species of slugs exhibit a large capacity for survival in areas which have suffered severe human interference and will colonize modern hedgerows and plantations. To understand why this is so would require a much more precise knowledge of the needs of each species than we yet possess. Climate is a complicating factor. For example, *Helicodonta obvoluta* is a common hedgerow species in parts of France and central Europe but here, at the northern limit of its geographical distribution, is distinctly particular in its requirements. The decline in temperature since the climatic optimum of the Post-glacial has undoubtedly done such molluscs a disservice; their local disappearance cannot be entirely blamed on man.

It is arguable that the effects of agriculture on the fauna have been more beneficial than otherwise. The variety of habitats available within limited areas has undoubtedly been greatly increased. Forest, often deeply shaded and with but a scanty ground flora, has nearly everywhere given place to a mosaic of environments, all of which may contain distinctive populations of snails: relict woodland, scrub, hedgebanks and ditches, the grassy margins of fields and roads, quarries and stone walls. The creation of several thousand miles of new hedgerows as a consequence of the enclosure acts of the eighteenth and early nineteenth centuries should not be forgotten. In acid or neutral areas the arable land would be limed, and fine calcareous dust, blown from the topsoil or from the broken limestone dressings of pre-motor-age roads, has 'fertilized' many unpromising places.

These changes have greatly altered the geographical distributions of our 'native' species, i.e. those which reached Britain by migration from the south before the beginnings of serious human disturbance in the Neolithic. Although a species may be in this sense indigenous, its presence within a particular area may entirely depend on man having created suitable habitats to which it has subsequently migrated. Such species cannot strictly be said to have been spread by man and, unlike *Limax flavus* L. or the common nettle, may exhibit no special association with his works. Examples are provided by many snails known to have been common in the open landscape of the Late-glacial Period, such as *Cochlicopa lubricella* (Stabile), *Pupilla muscorum*, *Abida secale* (Draparnaud), *Vallonia costata* (Müller), *V. excentrica* Sterki and *Helicella itala* (L.). Widely exterminated by the growth of forests, they were again able to expand in the wake of human clearance. Their powers to do so appear very unequal: *Vallonia excentrica* has been extremely successful, whereas *Abida secale* has made but a feeble come-back (KERNEY, 1962). In general, agriculture has entailed a drying-up of the landscape, favouring xerophiles at the expense of hygrophiles.

Geological evidence can sometimes directly reveal to us the effects of clearance. For instance, samples taken at intervals through chalky deposits of Post-glacial age in the bottom of a dry valley in East Kent showed a forest fauna giving place to one of grassland, at a level representing the beginnings of Early Iron Age farming on the downs above (KERNEY *et al.*, 1964).

Stone walls have provided important secondary habitats for a number of species, notably *Pyramidula rupestris* (Draparnaud), *Lauria cylindracea* (da Costa), *Helicigona lapicida* (L.), *Vertigo pusilla* Müller and *V. alpestris* Alder, which might otherwise be scarcer than they are. BOYCOTT (1929) has demonstrated the curious fact that in the Lake District *Vertigo alpestris* is almost entirely restricted to walls, and is rare or absent in 'natural' habitats within the same area.

Marsh snails have inevitably declined, for man has always tended to sharpen the boundary between water and dry land by eliminating places of intermediate character. Some species common in the Atlantic Period have become rare relicts (*Vertigo moulinsiana* (Dupuy), *V. angustior* Jeffreys); others, though still to be found in suitable environments throughout Britain, have been reduced in proportion to the disappearance of their habitats.

The general effect of clearance has been greatly to diversify a relatively homogeneous natural environment. In the case of the less adaptable species and those whose potential for migration is poor, innumerable barriers have been created, isolating one breeding community from another. Such a situation might be thought to favour the emergence of local races, but the time available has been far too short, and the principal result has probably been to render small communities more vulnerable to extinction.

Man has affected freshwater species in a rather different way and for the most part they have been less subject to his influence. A very large number of ponds in lowland Britain are of artificial origin, as are the drainage ditches of flood plains and reclaimed marshlands. All these speedily acquire characteristic Mollusca, and sometimes even provide sanctuaries for rare, indigenous species (*Valvata macrostoma* Mörch, *Planorbis vorticulus* Troschel, *Pisidium pseudosphaerium* Favre). Of particular importance to those forms which have only limited powers of natural migration was a making of a national system of canals and canalized rivers between about 1760 and 1830. BOYCOTT (1921 b, 1936) has pointed out how closely the distribution of a number of species (*Theodoxus fluviatilis* (L.), *Viviparus viviparus* (L.), *V. contectus* (Millet), *Bithynia leachi* (Sheppard), *Unio pictorum* (L.), *U. tumidus* Philipsson, *Sphaerium rivicola* (Lamarck) and others) corresponds to the 'canal basin', i.e. that region of England and Wales lying within the catchment area of the canal system. Canals are usually extremely favourable habitats, unless much disturbed by dredging or heavily polluted by fuel oils. Mr STELFOX has suggested to me that in Ireland the linking of the basin of the Shannon with that of the Boyne and Liffey by the construction of the Royal Canal may have favoured the spread of *Theodoxus fluviatilis*, *Bithynia leachi* and *Lymnaea glutinosa* (Müller). Other British species whose ranges have undoubtedly been extended by man are *Lymnaea auricularia* (L.), *L. stagnalis* (L.), *Planorbarius corneus* (L.), *Anodonta* spp., *Pisidium amnicum* (Müller), *P. supinum* Schmidt, *P. henslowanum* (Sheppard) and *P. moitessierianum* Paladilhe.

SYNANTHROPIC SPECIES

Britain being an island, a distinction is commonly made between species which are indigenous and those which are acclimatized aliens. This distinction, however, is not particularly helpful in understanding the varying status of any species from place to place; the geographical distributions of many of our snails, whether native or alien, have been greatly altered by man. His rôle has been to create new habitats for a considerable number of species, which they have been able to invade by their own unaided powers. Common snails of chalk grassland (*Vertigo pygmaea* (Draparnaud), *Pupilla muscorum*, *Vallonia excentrica*, *Cochlicopa lubricella*, etc.) are in this category. Others, however, possess a more special relationship with man in that they appear to be spread directly by him and tend to live in close proximity to his settlements. Familiar forms are *Testacella* spp., *Helix aspersa* Müller, *Oxychilus draparnaldi* (Beck), *Milax* spp. and *Limax flavus*. A particularly interesting case is that of *Hygromia striolata* (C. Pfeiffer). In the south of England it has a fossil record which shows it to have been present at least by the Boreal Period. Here it is found in a wide variety of places, including old native woodlands, but it is especially fond of the sort of unkempt, scrubby vegetation found on roadside verges, overgrown rubbish tips, and neglected gardens. In the north of England, in Scotland, and in Ireland, it is largely restricted to habitats of this sort, and there is a great deal of evidence to suggest that its spread is extremely recent and was effected directly by human agency (Stelfox, 1913; Boycott, 1921 a). It may even be that *Hygromia striolata* could not continue to exist in these northern parts of Britain if human interference ceased, for the kind of habitats it frequents would probably disappear.

It is useful to distinguish species having such relationships with man as *synanthropic* (or *anthropophilic*), although the term is not precise and its application will vary from place to place; a species which shows marked synanthropic tendencies in one region may altogether fail to do so in another. Interesting examples are afforded by the behaviour of several common British land snails in Scandinavia. In the neighbourhood of Stockholm, *Discus rotundatus* and *Hygromia hispida* (L.) have been spread by man beyond their native limits in Scania [Skåne], and live only in disturbed and more or less artificial habitats (Waldén, 1955). In France, conversely, we find that *Limax flavus*, here 'domesticated to about the same degree as the house mouse or cricket', lives in ancient woodland. Boycott (1934) has discussed why Mollusca at a climatic or other disadvantage may find such habitats favourable.

The status of a species in any particular spot may clearly be very complex. We can rarely be in full possession of the facts, for historical knowledge is normally lacking, but nevertheless it is often possible to frame intelligent hypotheses from observations of the nature of the environment, the plant and animal associates, and so on. Stelfox (1912: 11; 1914) has suggested the use of a flexible notation adopted from the botanists, and it is a pity that it has not been more used.

The Problem of alien Species

Man has not only altered the distribution of our indigenous species, but has been indirectly responsible for adding a considerable number during the period that Britain has been an island. For certain of these introductions we have fairly reliable historical information. In the twentieth century *Hygromia limbata* (Draparnaud) and *H. cinctella* (Draparnaud) have become established, whilst *Lymnaea catascopium* Say, *Fruticicola fruticum* (Müller) and *Helicella neglecta* (Draparnaud), after flourishing for a few years, now seem to be extinct. For the last century, likely introductions are *Potamopyrgus jenkinsi* (Smith), *Bythinella scholtzi* (A. Schmidt), *Menetus dilatatus* (Gould), *Helicella elegans* (Gmelin), *Sphaerium transversum* (Say) and *Dreissena polymorpha* (Pallas). Most are still local, but the *Sphaerium* and the *Dreissena* have spread widely by means of canals and waterways, and *Potamopyrgus jenkinsi* has been outstandingly successful, sometimes competing to a disastrous degree with the indigenous fauna.

Our knowledge of introductions of earlier date must rely on the evidence of palaeontology, which is at best negative, and in the case of slugs usually unobtainable. The problem is well illustrated by our common helicellids. One of these, *Helicella itala*, was abundant on calcareous ground in southern England as early as the Late-glacial Period, being greatly favoured by the open conditions then prevailing. For the remaining species—*Helicella caperata* (Montagu), *H. gigaxi* (L. Pfeiffer), *H. virgata* (da Costa) and *Cochlicella acuta* (Müller)—geological evidence is very scanty and capable of two quite different interpretations. They are unknown in the Late-glacial Period. It is possible that they reached this country by migration from the south in the earlier part of the Post-glacial (Holocene) Period but, owing to the paucity of suitable habitats in a forested landscape, remained very local until such time as clearance and cultivation favoured their spread. *H. virgata* is indeed known to have existed in Britain during some part of the Last Interglacial. We have no certain records from the time of the climatic optimum, but this is hardly surprising in view of their presumed rarity and the fact that, being xerophiles, their shells would not often become incorporated in the lake and marsh deposits which have provided us with most of our knowledge of the period.

Kennard (1923) suggested that some of these species are indigenous in south-west England. At Harlyn Bay, Cornwall, *Helicella caperata*, *H. virgata* and *Cochlicella acuta* are recorded fossil from blown sands associated with Early Iron Age burials (Bullen, 1902), whilst at Newquay the two latter species occurred at levels within ancient dunes considered to be 'Neolithic' or earlier (Kennard & Warren, 1903; Woodward, 1908). Such coastal habitats would indeed have provided ideal refuges for xerophiles during the forest phase of the Post-glacial. But unfortunately the stratigraphical and archaeological evidence for dating the faunas is far from satisfactory, and their true age must for the time being remain uncertain. Moreover, at least in the case of the Harlyn Bay deposits, we are well on into the period of human disturbance when the possibility of introductions cannot be discounted.

The helicellids have spread greatly in very recent times. Apart from *Helicella itala*, they are unknown fossil over most of Britain, even in quite modern deposits of suitable character. *Helicella gigaxi* occurs in a few post-Roman hillwashes in the south of England. *Helicella virgata* is perhaps first known in the south-east in a brackish-water deposit with *Cardium* and *Hydrobia ulvae* (Pennant) at Brookland, Kent, in a part of Romney Marsh thought to have been reclaimed from the sea between A.D. 1240 and 1270 (Kennard MS.). *Helicella caperata* is similarly a modern invader nearly everywhere; in parts of north-east Ireland where it now abounds it appears to have been absent as recently as the early part of the last century (Thompson, 1841). In the west of Ireland, many of the sand dunes carry millions of living *Cochlicella acuta*, *Helicella virgata* and *H. caperata*, species nevertheless entirely absent from the older 'shell-pockets' and buried land surfaces within the dunes, where only *H. itala* is found. The ease with which the helicellids will colonize newly made habitats, such as road cuttings and reclaimed marshlands, has often been observed. In addition, most will tolerate a high degree of cultivation, although they are equally common in 'wild' places and show no special association with man. Their status in Britain is problematical. It may even be that they are not here indigenous, but have been spread up the western seaboard of Europe from their Mediterranean homes by accidental transport with foodstuffs and merchandise from late prehistoric times onwards.

Monacha cantiana (Montagu) is more certainly an alien, first found in Roman deposits in Kent (KERNEY *et al.*, 1964). It favours long grass and weeds on roadside verges, often in the company of *Hygromia striolata*, and has reached as far north as Fife and as far west as Pembroke. *Helix aspersa* also may well be in the same category. Though common in Roman levels, all pre-Roman fossil records have proved either erroneous or doubtful. The supposed 'Upper Pleistocene' finds of this species (and also of *Helicella caperata* and *Cochlicella acuta*) from the west country (KENNARD, 1924) must also be rejected: they are based on shells from cavern deposits which have almost certainly suffered disturbance in modern times. Judging from the ease with which this Mediterranean snail has been carried all over the temperate regions of the globe within the past few centuries, its arrival in Britain may plausibly be ascribed to the period of substantial commercial trade with the European mainland which began late in the Iron Age, about the beginning of the first millennium A.D. Although only too familiar as a pest of gardens and cultivated places, *Helix aspersa* has, in the more oceanic parts of Britain, successfully invaded natural habitats, living in old woods and by sea coasts. *Helix pomatia* L., also known from Roman levels, may similarly prove not to be indigenous: there is at least no conclusive evidence to prove wrong the popular belief that it was deliberately introduced by the Romans for food although, if this is so, it is curious that no heaps of discarded shells seem to have been noticed in rubbish pits of the time.

Another species that is perhaps an introduction of very recent standing is *Theba pisana*, a member of the Mediterranean-Lusitanian element of our fauna sometimes claimed as 'pre-glacial'. But *T. pisana* is easily killed by frost, and its *in situ* survival in Britain during the Last Glaciation would seem extremely improbable. At the earliest, it can hardly have arrived before late in the Boreal Period. The absence of all reliable fossil records, together with its notorious facility in warmer climates for casual dispersal, makes it likely that *T. pisana* has been accidentally introduced into its coastal habitats, perhaps with jettisoned ballast.

Vitrina pyrenaica (Férussac), known only from a small area on the boundary between Co. Meath and Co. Louth, is another doubtful native. Its habitats have been much altered by eighteenth- and nineteenth-century landscaping, raising the suspicion that it may have been introduced with alien plants.

We come lastly to a group of molluscs which are largely synanthropic: the three species of *Testacella*, *Oxychilus draparnaldi*, the three common *Milax* species, *Limax flavus*, *Agriolimax caruanae* Pollonera and perhaps *Arion lusitanicus* Mabille. Occurrences away from human disturbance are sufficiently sparse to excite notice. *Testacella maugei* has been found in a wood in Glamorgan and in old pasture in Somerset (BOYCOTT, 1934). R. A. PHILLIPS records a shell of *T. haliotidea* Draparnaud in a wood in Co. Cork (PHILLIPS MS.). In the west and south-west, *Oxychilus draparnaldi*, *Milax sowerbyi* (Férussac), *M. budapestensis* (Hazay) and *Agriolimax caruanae* occasionally live at some distance from settlements, and *M. gagates* (Draparnaud) is not uncommon in 'wild' places near the sea. The evidence of geology casts little light on the Post-glacial history of these species. Possibly some may be indigenous, but remained rare until man provided them with congenial habitats. It is interesting to note that internal shells of *Agriolimax* cf. *caruanae* and of *Milax* sp. are known from deposits of the Last Interglacial (SPARKS, 1964), so that a Post-glacial re-immigration is by no means improbable. The former species has been recorded from Holocene deposits of uncertain—but probably late prehistoric—date in Cambridgeshire and Essex (HAYWARD, 1954), and from a Sub-Atlantic deposit (post-500 B.C.) in Northamptonshire (SPARKS & LAMBERT, 1961). Whether or not all these forms are indigenous, there can be no doubt that they have attained their present wide distribution through the agency of man. In no sense are they 'native' over most of their ranges, and it is likely that they would become very much rarer if human interference were to cease.

ENVOY

The populations of land and freshwater molluscs living in Britain must not be thought of as static, but as existing in a complex interaction with the forces exerted by the changing environment. Between about 5,000 and 3,000 B.C., when the climatic optimum of the Post-glacial had been reached and climax forest covered large areas of the country, it is possible that some kind of precarious balance was struck, the situation altering little from century to century. But once the environment had begun to be seriously affected by man the fauna once again entered a period of rapid change, some species retreating or acquiring discontinuous ranges, others spreading into freshly created habitats. Equilibrium can never be reached. In general, man has tended to increase the variety of the molluscan fauna, both by raising the total number of species present in these islands, and by introducing ecological diversity where before had been relative uniformity.

Since, then, man has largely created the environment, what should be his rôle in preserving that environment, together with its associated animal and plant life? It might be argued that specially to protect, say, a piece of chalk downland or a canal would be, from a scientific point of view, merely to fossilize a situation which is in the first place artificial, and that since uncontrolled human activity in the past has produced, on the whole, favourable results, this will continue to be so in the future. There can be no doubt, however, that a crucial stage has been reached in man's relationship with his surroundings. Since about the year 1800, the processes of industrialization and the pressures exerted by a rising population have, over many square miles of Britain, replaced an agricultural landscape with one that is wholly man-made. Over further areas, atmospheric pollution has reduced the terrestrial fauna, and the contamination of fresh water killed that of streams and rivers. In the last fifty years the development of the internal combustion engine has enabled industry and human settlement to escape from the cities and spread thinly over whole regions. Restrictions formerly imposed by climate and geography have ceased to carry weight. In the country, new ways of farming—involving the removal of hedgerows and ditches, the filling of ponds, the elimination of waste ground, and the widespread application of insecticides—tend to create biologically sterile wastes in which even the most anthropophile of molluscs finds it hard to exist. Change now differs not merely in pace but essentially in kind from that of the pre-industrial centuries. It would be a sad reflexion on our civilization if, in exchange for an ever-greater mastery over natural resources, we were to impoverish our environment and condemn much of its animal and plant life to survival only in a few national parks and reserves.

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J. Conch. **26**: 15–18. (1966)

RADULAE OF FOUR SPECIES OF MITRIDAE (MOLLUSCA: GASTROPODA)

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(*Read before the Society*, 16 *October* 1965)

Abstract

The radulae of four species of Mitridae have been examined. *Mitra tristis* Broderip, 1836, is transferred to the genus *Strigatella* Swainson, 1840, and *Strigatella litterata* (Lamarck, 1811) is confirmed to be correctly placed in that genus. *Mitra chrysalis* Reeve, 1844, belongs to *Mitra* s.s. and not *Chrysame* Adams & Adams, 1853, to which genus it is occasionally assigned. The radula of *Imbricaria punctata* (Swainson, 1821) confirms the validity of the genus *Imbricaria* Schumacher, 1817; morphological characters and radula pattern clearly separate this group from the other genera of Mitridae.

A classification and generic division of mitrid species based purely on morphological characteristics of the shell is not only unsatisfactory but taxonomically inconclusive. In certain genera, i.e. *Vexillum* Röding, 1798, *Pterygia* Röding, 1798 and *Imbricaria* Schumacher, 1817, morphological characters are on the whole well defined, but they are less clear and even obscured, however, in the genera *Pusia* Swainson, 1840, *Cancilla* Swainson, 1840 and *Strigatella* Swainson, 1840. The correct generic placement of those mitrid species which could tentatively be assigned to either of two genera should be confirmed by radula studies and ecology. In certain genera of Mitridae, ecology and feeding habits are diverging, and radula and live animal-pattern are modified as a result.

Members of the genus *Strigatella* are primarily coral-reef dwellers, inhabiting the underside of coral or basalt boulders in the intertidal zone, and cracks and crevices of coral-reef flats. The sole of the foot is generally white or cream-coloured, while the dorsum of the foot is usually uniformly chestnut-brown. Tentacles are short and the eyes small in relation to shell-length, in contrast to the long, slender tentacles and well-developed eyes of *Vexillum* species, which are primarily sand-dwellers with established carnivorous feeding habits.

Strigatella tristis (Broderip, 1836) [Fig. 1]

Proc. zool. Soc. Lond. **for 1835** (3): 194 (not figured).

Specimens examined were collected intertidally at Puertecitos, Baja California, Mexico, by H. Du Shane in 1964.

Shell-length of specimens examined ranged from 25·6 mm to 27·3 mm. The length of the radular ribbon varied from 2·4 mm to 3·1 mm, the width from 0·3 mm to 0·4 mm. The fully-formed rows numbered from 46 to 52, plus nascentes (15 to 23 nascentes). The centrals are rectangular, broad and short, with five main cusps. Laterals are more than twice as broad as the centrals, cleaver-shaped, and with 10 to 11 cusps which are distributed over two-thirds of the width of the plate. The last two or three cusps are small, and appear more or less like small denticles.

The species is generally assigned to the genus *Mitra* s.s. The radula-pattern, however, is very similar to that of *Strigatella litterata* (Lamarck, 1811), and the species should therefore be removed to the genus *Strigatella.*

Strigatella litterata (Lamarck, 1811) [Fig. 2]

Annls Mus. Hist. nat., Paris **17**: 220 (not figured).

Specimens examined were collected intertidally at Korotogo, south Viti Levu, Fiji Islands, by the author in 1965. They were found attached to the underside of coral rocks in shallow water.

Shell-length of specimens examined ranged from 19 mm to 21 mm. The length of the radular ribbon varied from 2·8 mm to 3·2 mm, the width from 0·5 mm to 0·65 mm. The first two to three rows of the ribbon were worn in a 'cone-shaped' fashion: in the first row the central was worn but still intact, while the two laterals were worn away to about one-third of their normal width; in the second row the laterals were worn away to half their width; in the third row only about a quarter of each lateral was worn off. It appears that the species sweeps and grazes over the detritus layers of the coral substrate, detaching micro-organisms for food.

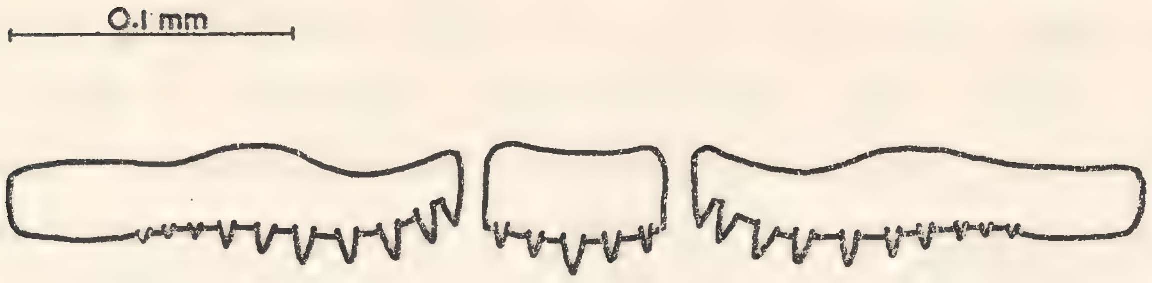
The fully-formed rows numbered from 56 to 64, plus nascentes. The centrals are roughly rectangular in shape with 5 to 6 main cusps. The laterals are two and one-half to three times as broad as the centrals, and have 9 to 11 main cusps, the last two cusps becoming small denticles.

Mitra chrysalis Reeve, 1844 [Fig. 3]

Conchologia Iconica **2**: pl. 25, sp. 200.

Specimens examined were collected intertidally at Cuvu beach, south-west Viti Levu, Fiji Islands, by the author in 1965. They were found under coral rocks in sand-pools, exposed on sand substrate.

Shell-length of specimens examined ranged from 16 mm to 18 mm. The length of the radular ribbon varied from 1·7 mm to 2·2 mm, the width from 0·5 to 0·7 mm. The fully-formed rows numbered from 28 to 34, plus nascentes.



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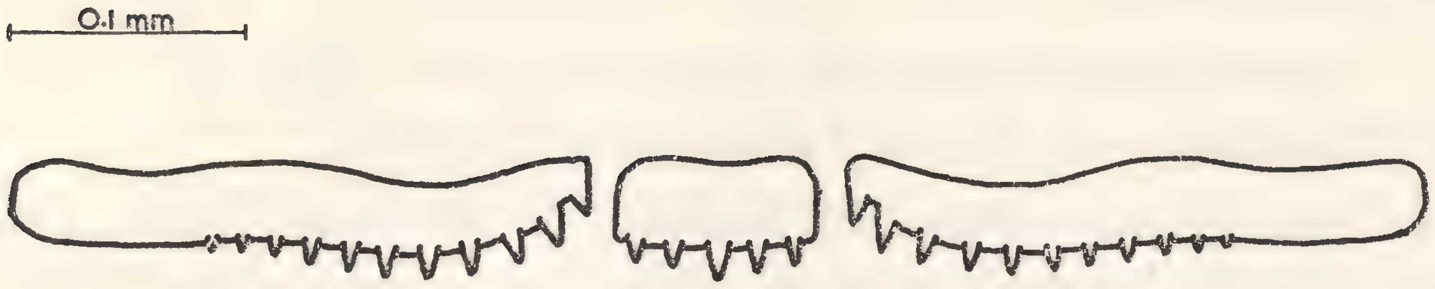

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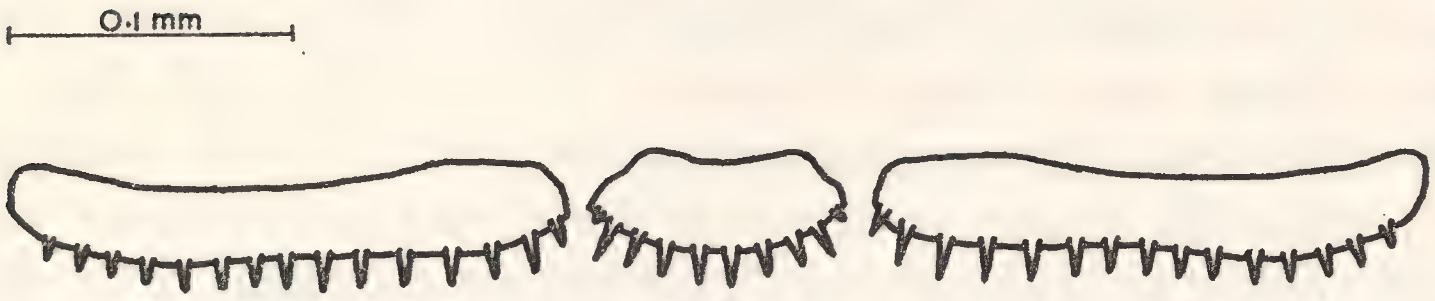

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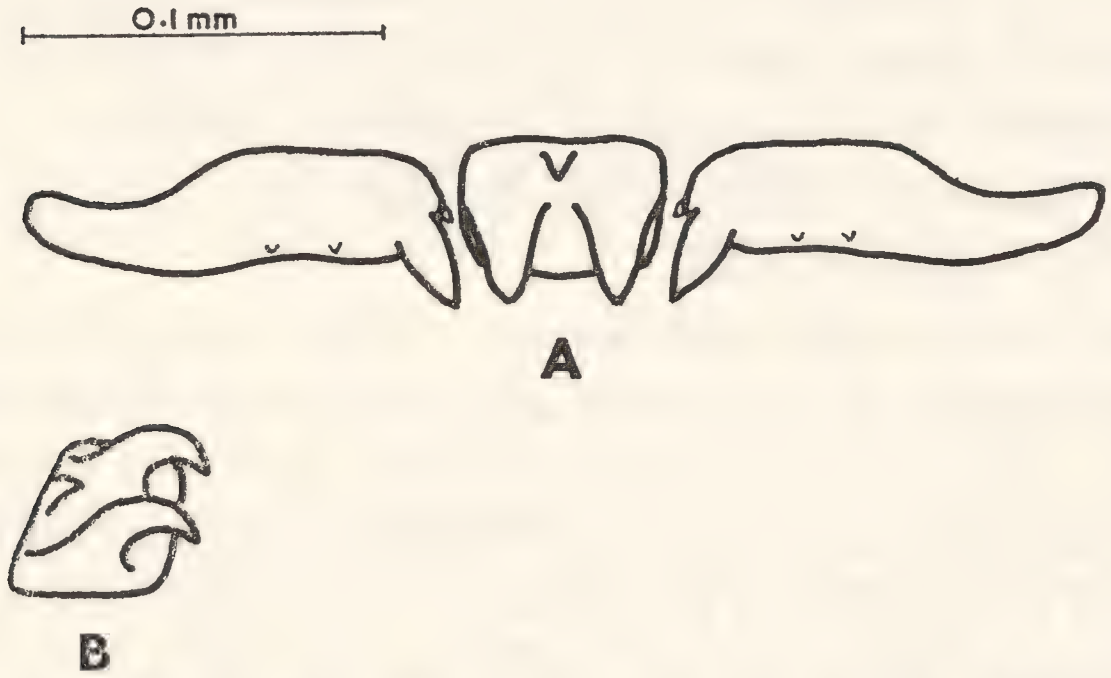

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Fig. 1. *Strigatella tristis* (Broderip). Mexico. One row of teeth. **Fig. 2.** *Strigatella litterata* (Lamarck). Fiji Islands. One row of teeth. **Fig. 3.** *Mitra chrysalis* Reeve. Fiji Islands. One row of teeth. **Fig. 4.** *Imbricaria punctata* (Swainson). Fiji Islands. **A** One row of teeth. **B** Latero-oblique view of central tooth.

The centrals are roughly trapezoidal in form, broader than they are long, and with 8 moderately long main cusps, which are flanked by a small denticle on each side. These small denticles are either slightly longer or even absent in some specimens. The laterals are broad and short, two to two and one-quarter the width of the centrals, with 14 to 16 main cusps which are distributed along almost the entire width of the lateral plate.

The live animal has the sole of the foot cream or light fawn, and profusely spotted with snow-white; the dorsum of the foot is cream in colour. The siphon is yellowish, the tentacles are pale yellow, the base of the tentacles cream and spotted with white, and the eyes black.

The species is generally placed in the genus *Chrysame* Adams & Adams, 1853, on shell-characters alone. The radula-pattern, however, is that of the genus *Mitra* Röding, 1798, s.s., and the species should be removed from *Chrysame*. From PEILE's (1937) description, the radula of *Mitra cucumerina* Lamarck, 1811, is very similar to that of *M. chrysalis* Reeve, and was confirmed by PEILE to belong to the genus *Mitra*.

Imbricaria punctata (Swainson, 1821) [Fig. 4]

Zoological Illustrations (ser. 1): pl. 24, two lower figures.

Specimens examined were collected intertidally at Cuvu beach, south-west Viti Levu, Fiji Islands, by the author in 1965. They were dredged in fine silty-sand substrate in 4 ft of water.

Shell-length of specimens examined ranged from 13 mm to 15 mm. The length of the radular ribbon varied from 1·8 mm to 2·1 mm, the width from 0·25 to 0·3 mm. The fully-formed rows numbered from 32 to 37, plus nascentes. The centrals are rectangular or almost square in shape, and are equipped with two large hook-like cusps; an accessory denticle is positioned centrally on the upper edge of the plate. The laterals are cleaver-like in appearance with a large broad cusp pointing inward towards the centrals; the side-denticle next to the main cusp is either small or absent, and the two small denticles on the lower edge of the laterals were absent in one specimen examined. The laterals are about one and three-quarters times the width of the centrals. No wear was discernible on the early rows of the radular ribbon.

The live animal has the sole and dorsum of the foot white in colour. The siphon is long and white, the tentacles are moderately short and white with light brown edges, the base of the tentacles white, and the eyes black.

The radula-pattern of *Imbricaria* is quite distinct from the radulae of the coral-dwelling *Mitra* and *Strigatella* and from that of the sand-dwelling *Vexillum*. The radula of *Vexillum* consists of a very broad comb-like central with 12 to 14 main cusps and curved, hook-like laterals. The two large, hook-like cusps on the centrals and inward-pointing cusp on the laterals of *Imbricaria punctata* are particularly suited to a tearing and shredding technique of feeding, and not for sweeping and grazing over the substrate.

ACKNOWLEDGMENT

I am indebted to Mrs J. CATE of Los Angeles for the specimens of *Strigatella tristis* (Broderip) from her collection. Although collected nine months prior to examination, they were in an excellent state of preservation.

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J. Conch. **26**: 19–25. (1966)

THE REDISCOVERY OF *THEBA PISANA* (MÜLLER) IN CORNWALL

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(*Read before the Society*, 13 *March* 1965)

INTRODUCTION

In September 1964, Mr CHARLES THOMAS drew my attention to a colony of *Theba pisana* (Müller) at St Ives, Cornwall, on the promontory known as The Island which projects northwards beyond the town [National Grid reference: SW 521410]. Having searched in vain for *T. pisana* on The Island only a few years ago, and knowing that this species has not been reported in Cornwall in recent times, I became interested in the factors which might limit its very restricted distribution at St Ives and in its history in Cornwall.

HISTORY OF *Theba pisana* IN THE BRITISH ISLES

Theba pisana lives, often in immense numbers, all round the Mediterranean, usually near the coast but extending inland in Italy, the Iberian peninsula, the south of France and Morocco. It has been introduced into other parts of the world, including South Africa, Australia and North America: wherever the right combination of warmth, shelter and food occurs it flourishes prodigiously, as in California where 'it became a pest by defoliating citrus trees' (QUICK, 1952: 182). It has also become a serious nuisance in Morocco and Israel. On the western seaboard of Europe it extends to the Atlantic and Channel coasts of France and has been introduced into Belgium. (For details of distribution see TAYLOR, 1912: 392–397.)

Theba pisana, originally described by PETIVER in 1711, was first recorded as a British species by PENNANT (1777) under the name *Helix zonaria* and without any locality, though the habitat is given as 'dry banks'. Since then, *T. pisana* has been recorded from the Channel Islands, Cornwall, Dorset, Pembroke (Saundersfoot to Manorbier), Glamorgan (Porthcawl, Swansea) and the east coast of Ireland (Rush to Clogher) (TAYLOR, 1912: 394; QUICK, 1943: 10). Monsieur T. RENÉ DEBLOCK, who undertook a large-scale survey of the species and visited all the recorded British localities in 1961, failed to find it in either Cornwall or Dorset; his thesis is not yet published.

Theba pisana has never been recorded from any British Post-glacial deposit, although there is a record from a Neolithic site in Jersey.* The absence of any fossil record suggests its introduction by human agency within the past few centuries. Its presence in Holocene deposits may yet be detected, as the study of shells found in the course of excavations remains a rarely explored aspect of archaeology, in spite of its acknowledged importance. Some support for the opinion that the species is indigenous to the British Isles is afforded by its geographical range, which resembles that of certain species of animals which form part of the Lusitanian element of our fauna (BEIRNE, 1952: 87). It could have been introduced with ships' ballast (RIMMER, 1880: 133) or cargoes, in which connexion it may be relevant that, at its Cornish station: 'The eastern tip of Porthgwidden Cove is formed by an old town dump, now flattened off for the ubiquitous car park. The base of this dump yielded to BRET GUTHRIE and myself, some years ago, pottery which suggests that it has been the town dump for centuries. Now this pottery specifically includes not only the usual Barnstaple ware, but a kind of sgraffito earthenware known to be of Breton provenience. Some sherds of this "found on The Island" by the late R. M. NANCE are deposited in the St Ives museum. It could certainly be older than 1790.' (C. THOMAS *in litt.*, 1 xii 1964). Another possibility, favoured by Mr J. F. PEAKE, is that it was introduced for food. It is commonly eaten in the south of France and in Italy, where it was collected in great quantities for sale in the markets (LOVELL, 1867: 16; ADAMS, 1884: 69). Deliberate attempts at naturalization have also contributed to its spread, *T. pisana* appealing to conchologists for its beauty and rarity (KEW, 1893: 188–191). The maritime habitat, however, may just be due to the snail's sensitivity to frost, as it becomes more of a coastal denizen towards the northern limits of its range.

Theba pisana IN CORNWALL

In the past 168 years there have been frequent references in conchological literature to the occurrence of this species in Cornwall, though many of them have just been copied from earlier authors without any attempt to check whether it still occurred in the county. The earliest Cornish record and the first localized British record is that of MATON (1797: 227) who, with the Revd THOMAS RACKETT, travelled through the western counties in 1794–1796 to record 'the natural history, picturesque scenery and antiquities'. Of St Ives, MATON writes: 'On the rocks about the shore we met with *Helix maculosa*. This shell, from not having been noticed in England before, may be considered as one of the rarest species; it is also one of the most elegant. In form and colour it approaches so nearly to the common snail of our downs (*H. ericetorum*? of Gmelin) that it is very likely to be confounded with it, but the size will be found to be considerably larger.' RACKETT also recorded this species (as *Helix cingenda*) as 'abundant at St Ives in plants near the sea' in HUTCHINS's *History of Dorset*, and in the same work he writes of it as occurring between Lulworth and Weymouth in Dorset, 'but I believe it to be very rare' (PULTENEY, 1813: 53). MONTAGU (1803: 419), writing of his *Helix cingenda*, says: 'Mr RACKETT informs us, he found it near *St Ives* in *Cornwall*, on the slope of the hill descending to the town', and also mentions finding it himself at Tenby twelve years before. [*H. maculosa* Maton (non Gmelin) and *H. cingenda* Montagu = *H. pisana* Müller; *H. ericetorum* Maton (non Müller nec Gmelin) = *H. virgata* (da Costa).] COUCH (1841: 46) notes: 'The only place in the west of England where this snail is found is at St Ives, chiefly about the promontory north of the town; where it exists in profusion. A sandy soil is perhaps necessary to its existence.' TAYLOR (1912: 393) records it as 'formerly and probably still in profusion at St Ives, on the slopes of the hill descending into the town and chiefly about the promontory to the north. It is also recorded from Falmouth by Mr W. P. COCKS, and specimens thus labelled are in the British Museum; by Dr LEACH from Whitesand Bay, and it has been found at Crantock near Newquay by Rev. A. H. MELVILL'. COCKS lived in Falmouth from 1842 until his death in 1878, but there seems to be no mention of *H. pisana* in his *Fauna of Falmouth* published by the Royal Cornwall Polytechnic Society in 1849 and the addenda of subsequent years, nor have I been able to trace any other records from Falmouth; probably this was a very temporary colony. There are two Whitesand Bays in Cornwall, one on the south coast west of Plymouth and the other on the west coast north of Sennen: the latter is probably LEACH's locality. Incidentally, he does not state that he actually found the snail there himself (LEACH, 1852: 68).

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* The alleged Neolithic occurrence in Jersey is too doubtful to be accepted. The record is based on a single shell found quite close to the surface.

THE ST IVES COLONY

It is evident that the St Ives colony dates back to 1797 and is presumably older still. It is restricted to a small area on the side of The Island facing south-east, and no *T. pisana* are to be found elsewhere. Mr CHARLES THOMAS writes (3 x 1964): 'I first encountered the colony of *H. pisana* at St Ives about 1948 or 1949. At that time, I had been excavating in various sites in southern Britain, and became interested in the occurrence of Mollusca in the lower levels of prehistoric sites. This colony was then confined to the small cove called Porthgwidden, on St Ives Island, and occurred over the whole range of the cove—perhaps a hundred and fifty yards—being confined to a fairly steep slope some 15 to 20 ft long which can be seen above the beach itself, and below the grass plateau of The Island, now used as a car park. The vegetation here is fairly short and the site is exposed. I suppose that, since then, I have visited this site about once every eighteen months. A few years ago, St Ives Borough Council developed this cove, placing a crescentic two-tiered affair of beach huts along most of it. The slope is thus considerably restricted, and the only original patch left is to be found at the northern or north-western end, which now constitutes the main focus of this colony. In view of this I have twice attempted to found new colonies on the opposite side of the bay, at Godrevy, choosing localities which appear to reproduce the exact conditions at Porthgwidden. I am not sure whether this has been successful: one colony consisted of a dozen specimens, the other of two dozen. Recently I placed a further dozen on a sandy patch in my garden in Gwithian churchtown. Apart from this, I have occasionally taken empty shells for study, and have shown the site to two amateur conchologists in, I think, 1959 and 1960.'

Apart from the destruction of its habitats by building, both on The Island and on the slopes of the hill descending into St Ives, there remains the problem of why this species should have died out at other localities in Cornwall where it is reputed to have occurred, and why it has not spread to other parts of The Island. The colony is a flourishing one in so far as there are several hundreds of individuals within this small area, but it is manifestly in a precarious position, as it could easily be wiped out by further 'development' or by rapacious collecting, such as exterminated *Helicella neglecta* (Draparnaud) in its Kentish station.

Possible limiting Factors in the Ecology of *Theba pisana*

Temperature

Monsieur T. R. Deblock writes (6 xi 1964): 'Les fluctuations considérables dans la répartition de *T. pisana* sont dues à mon avis aux successions d'hivers plus ou moins rigoureux. À la limite de répartition, une espèce est extrêmement sensible aux changements de rigeur dans les saisons. C'est ainsi qu'en certains points de notre côte *T. pisana* a subi de lourdes pertes et a même disparu en raison des deux hivers rigoureux que nous venons d'avoir.' As the climate of Cornwall is as mild and equable as any in the British Isles, it would be expected that, as *T. pisana* can withstand the winters of South Wales and Ireland, it could equally well tolerate those of west Cornwall.

Theba pisana is adapted to withstand hot and dry conditions, habitually aestivating on the stems of plants, shrubs, posts, fences, etc., where the air is cooler than on the surface of the ground. Boycott (1934: 15) lists it as a xerophile together with *Helicella* spp. and *Cochlicella*, and writes: 'All the above species live exposed and unprotected on short grass. . . . They all have relatively thick, white, whitish or black and white shells which help them to tolerate the intense insolation to which they are often subjected and which they escape by climbing up the stalks of any available plants and so getting away from the overheated ground. *H. pisana* has unusually concentrated haemolymph. They make little attempt to burrow into the turf or get into any shelter.' JEFFREYS (1862: 209) states, however, that: 'Mr BARLEE informed me that at St Ives he procured live specimens by digging some inches in the sand-hills, at the roots of the *Carex arenaria*, where the snails had buried themselves, the weather being then very hot and the herbage not affording much shelter from the sun's rays.' CROWLEY (1961: 16) writes: 'The habit of this snail is frequently to bury itself, and possibly it will do this if conditions are not to its liking or it is sickly. This might account for the rarity of dead shells.' Writing of the same colonies on Guernsey he says (*in litt.*, 30 xi 1964): 'I could find no living specimens of *T. pisana* except in places directly sheltered from the wind, in a strip of a couple of feet wide at Vazon, behind the wall, though the vegetation extended out. Fresh fragments made me sure the species lived at Vale, but here the wind was high and dead on-shore, so their burial was a deduction and not an observation.' If *T. pisana* does indeed bury itself, and is not just accidentally covered with sand during sand-blows, it would seem that further research is needed to discover what weather conditions cause this reaction and for how long the snails might remain buried.

FOOD

Theba pisana has such catholic tastes and is so adaptable that its dispersal is unlikely to be limited by lack of a suitable food plant. Amongst food plants mentioned by TAYLOR (1912: 375) are thistles, *Raphanus*, *Cheiranthus*, *Teucrium*, *Eryngium*, *Opuntia*, *Agave*, *Peganum*, *Nerium* and *Euphorbia balsamifera*. At St Ives the snails were found chiefly on stems of carrot (*Daucus carota gummifer*) and *Plantago* spp., and amongst patches of *Petasites fragrans*; these and other acceptable food plants were found growing above the confines of the colony.

SOIL

Theba pisana is probably an obligatory calcicole, requiring a highly calcareous soil (BOYCOTT, 1934: 31), and hence is more likely to become established on the Atlantic coast of Cornwall, where blown shell-sand forms extensive dunes. Although The Island at St Ives is not composed of sand dunes, the soil is sandy enough to give a high pH reading (7·5) and is sufficiently friable for snails to be able to bury themselves easily.

ASPECT

Theba pisana lives habitually above ground and ascends the stems of plants in all weathers and at all seasons, a habit which could cause casualties on the gale-swept Cornish coast. Although obviously possessing a fair degree of wind-hardiness to exist at all on such an exposed coast, it is noticeable that the snails do not occur much above the lee of the steep cliff-bank, except in the shelter of a hollow and under cover of the large leaves of *Petasites*, although there is plenty of vegetation suitable for food. CROWLEY (1961) describes a colony of *T. pisana* at Vazon, Guernsey, which has been similarly decimated by 'development' and where the remaining snails 'could be found only in the actual lee of the low wall, only one or two specimens being picked up in a dying condition four to six feet away from it'. Mr L. W. STRATTON (*in litt.*, 26 xi 1964) considers that more research is necessary to assay the effect of wind on *T. pisana* and writes, referring to the Tenby station, that: 'All the sites face either south or east, and it was probably somewhat sheltered, though it is not far from Dale, which is one of the windiest places in Britain. The prevailing winds are south-westerly, so I suppose the snails could get out of the way when very windy. However, it lives on Caldy Island, which is pretty exposed, though I have not seen the sites there. . . . The snails on the hogweed [*Heracleum*] at Tenby were completely exposed to any wind and had been there for some time, for many had formed an epiphragm, owing to a dry spell, but there was wind all the time I was there, enough to puff up the sand.'

INTER-SPECIFIC COMPETITION

As snails are not particularly fastidious and fresh or decaying vegetable matter is available in most places, it is unlikely that there can be much competition between species on downs and dunes. The species of snail associated with *T. pisana* at St Ives are *Helix aspersa* Müller, *Cochlicella acuta* (Müller), *Helicella virgata* (da Costa) and *H. caperata* (Montagu). Mr STRATTON informs me that the same species, together with *Helix nemoralis* L., occur at Tenby.

SUMMARY OF LIMITING FACTORS

The following critical factors seem to govern the occurrence of *Theba pisana* and its success as a colonizer would depend on the extent to which these are fulfilled.

1. A sunny aspect in a genial climate.
2. Comparatively frost-free conditions.
3. A highly calcareous soil.
4. Shelter from the prevailing wind.

The kind of food and the associated Mollusca are of less importance. *T. pisana* is exceptional in hibernating and aestivating to a large extent on the stems of plants, rather than sheltering at their base where the velocity of the wind may be reduced to a fraction of its force a few centimetres above the top of the vegetation. More research is needed involving actual measurement of wind force in various sites and to discover the conditions under which the snails will bury themselves.

SUMMARY

The rediscovery of *Theba pisana* (Müller) at St Ives, Cornwall, is reported and its history traced back to the end of the eighteenth century. The geographical range of *T. pisana* is typically Lusitanian, and it is suggested that there is not enough negative evidence from Post-glacial deposits to disprove its native status. If introduced within historical times, it may have been brought in deliberately for food or accidentally with ballast or imported goods. Its restriction to the vicinity of the sea-coast in north-west France and the British Isles is probably due to lack of hardiness. Consideration of other Cornish records indicates that the species has never had a strong foothold in the county except at St Ives, and even there the area colonized is shrinking. Apart from the devastating effect of building 'development', it is suggested that the factor limiting spread at St Ives may be exposure to strong wind, rather than unsuitable soil or deficiency of acceptable food plants.

It is essential that the little colony of *Theba pisana* lingering on at St Ives should be left undisturbed and carefully conserved, to insure the continued existence of this beautiful snail in its only known station in England.

ACKNOWLEDGMENTS

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CULTIVATION OF THE BLACK-LIP PEARL OYSTER *PINCTADA MARGARITIFERA* (L.)

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(*Read before the Society*, 15 *May* 1965)

INTRODUCTION

Mother-of-pearl, which has been used in the manufacture of pearl buttons, jewellery and inlay work for many centuries, is obtained from a number of nacreous molluscs, the most important of which are the pearl oysters of the genus *Pinctada*. The giant silver- or gold-lip oyster, *P. maxima* (Jameson), which is found around north Australia and the Philippines, produces nacre of the very best quality. Black-lip oysters, *P. margaritifera* (L.), are found around many of the Pacific islands, particularly Tahiti and the Cook Islands, and also in parts of south-east Asia, the islands of the Indian Ocean and throughout the Red Sea. Although the colour of the nacre of black-lip is not as popular as that of gold-lip, there is still a fair market for the former in spite of the severe competition from synthetics. There are many other species of this genus, but in only these two is the nacre of sufficient thickness to suit it to the above-mentioned uses.

Because of the unreliability of the fishery of natural stocks, many attempts have been made to cultivate these species, somewhat along the lines used for the culture of edible oysters and mussels. In Australia numerous attempts have been made over the past half-century; the Japanese have experimented in Okinawa, Borneo and several other Pacific islands; and the French have been endeavouring to cultivate pearl oysters in Tahiti for many years. Experiments have also been carried out in Manahiki Lagoon in the Cook Islands. But the only successful attempt to cultivate pearl oysters on a commercial scale, for the value of their nacre,* was made at Dongonab Bay, in the Sudanese Red Sea, by the late Dr CYRIL CROSSLAND during his stay there from 1905 until 1922. The scheme has now been re-started. Under almost unimaginably difficult conditions, and after many years of patient and painstaking investigations and experiments, CROSSLAND succeeded in collecting great numbers of the spat of

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* In Japan, *P. martensi* (Dunker) is cultivated. Pearls are cultured in this species, but the nacre is too thin to be of value.

P. margaritifera on artificial collectors and rearing them to marketable size. During the last few years of his stay in Sudan he was producing, from an area of a few square miles, a regular annual crop of more than 300 tons of pearl shell. By comparison, the present production of the whole of Dongonab Bay under natural conditions is about 7 tons annually, and the natural production of the whole of the Red Sea is less than 150 tons.

Much against the wishes and advice of CROSSLAND, the scheme was abandoned by the Sudan Government in 1922, when the price of Red Sea MOP (the trade name for mother-of-pearl) shell fell from the usual £100 per ton to the uneconomical level of only £20 per ton. It now seems that if CROSSLAND's advice had been heeded and the scheme had been continued on a reduced scale for a few years it would have proved financially profitable later and, as it has not since been cultivated in other parts of the world, a large percentage of the world's present requirements of MOP shell would probably be produced at Dongonab Bay by modern methods of cultivation. For various reasons CROSSLAND's original manuscript was left unpublished in the British Museum (Natural History) for many years, but in 1957 a revised and abbreviated version of the original was published in the *Australian Journal of Marine and Freshwater Research*. Soon after this I had the good fortune to work on the shell fisheries of this region, firstly in the employment of the Food and Agriculture Organization of the United Nations and latterly for the Government of the Sudan. The shell farm at Dongonab has now been re-started and the techniques have been simplified to such an extent that more than a hundred of the local, formerly nomadic, shell divers have now begun their own pearl oyster plantations. There are now over 1,000,000 oysters of various age under cultivation and the target production for the scheme is 100 tons per year.

PHYSICAL CONDITIONS AT DONGONAB BAY

Because all attempts in other parts of the world to cultivate this species have failed, it is worthwhile to make a close examination of the peculiar physical conditions of Dongonab Bay. The bay is almost like an atoll ring, approximately twenty miles long and five miles wide. The maximum depth is 25 fathoms and there are large areas of dead coral reefs and stony seaweeds (*Lithothamnion*) in depths of 2 to 12 fathoms, which are suitable for the fixation and growth of pearl oysters. The bay is sheltered from very rough weather and, because of the almost total absence of tides in this central part of the Red Sea, the currents are very gentle. The strongest current I have ever observed did not exceed one knot. The rainfall of this area is practically nil, so there is no freshwater run-off and consequent silting. A few hours' rain per year is the maximum at Dongonab and several years without a shower of rain is quite common. The most important peculiarity of Dongonab Bay, however, is probably the great annual variation in water temperature, when compared to other tropical areas where pearl oysters occur. It is probably the temperature, more than most other factors, which influences the spawning of pearl oysters. Because Dongonab Bay is a relatively small mass of shallow, comparatively stagnant water, it is more readily affected by air temperatures than the main body of the Red Sea. At Dongonab the sea temperature varies from 21°C or 22°C during January and February to 34°C during July and August, while in most other tropical seas the range is usually from about 26°C to 31°C. Such a large sheltered bay as Dongonab does not exist elsewhere in the Red Sea.

Species of Pearl Oysters at Dongonab

Black-lip pearl oysters, *Pinctada margaritifera* var. *erythraensis* (Jameson) are by far the most common of the Pteriidae in this part of the Red Sea. This variety is found in the Red Sea and also at Socotra Island and along the coast of southern Arabia at least as far as Bir Ali. The colour and quality of the nacre varies slightly in shells from different localities. This species produces very few natural pearls, though an occasional large and beautiful gem is found. Most natural pearls, however, are small, misshapen and of poor lustre. Other species which occur in small numbers under natural conditions, and are found on the spat collectors, are *Pinctada radiata* (Leach), *P. nigra* (Gould), *P. anomioides* (Reeve), and several species of Isognomonidae. At Dongonab all of these are ephemeral and, if transferred to growing trays, 90% of them die within a year.

Biology of *P. margaritifera* at Dongonab Bay

Crossland states that this species is dioecious, but Tranter (1958) found that sex changes occurred in the same species in Australia. There is no external difference, but when the oyster is opened the sexes can be distinguished quite easily, even without the aid of a microscope. The ovary of the female is creamy yellow and granular, while the testis of the male is white and apparently homogeneous.

Pearl oysters begin to breed in the summer of their second year. During the winter there is no trace of a gonad; development begins about March and continues until June. Discharge of eggs and sperm then occurs at intervals until September, when the gonads are again empty. The existence of such a well-defined spawning season seems to be confined to this part of the Red Sea. It is probably influenced chiefly by temperature. In March the average sea temperature is about 24°C, rising gradually to 32°C in June. In north Australia where the temperature varies from 26°C to 31°C this species spawns intermittently throughout the year. Fortunately, at Dongonab the spawning of *P. margaritifera* does not coincide with that of any other common organism which attaches to the collectors. (When two or more organisms spawn at the same time, the collectors are often covered with the larvae of the undesired species, to the exclusion of the required one.)

Development continues while the larva is planktonic, but eventually the weight of the rapidly forming young valves forces it to settle upon the sea bed. For a few weeks the young spat is able to move by means of a foot, but after this the foot degenerates and an attachment is made by means of the byssus. Under natural conditions, it is during this early stage that the pearl oyster endeavours to select a position on the vertical edge of a piece of dead coral 10 to 30 cm above the sea bed; there it probably gets a better flow of water and is away from some parasites and predators. During this critical stage an enormous mortality occurs. Most of the substrate is either reefs of live coral or mud and sand, both of which would be fatal to the delicate young larvae. The only suitable substrate is silt-free dead coral or stony seaweeds, and the chances of coming into contact with such are remote.

For the first year or so, until the shells are sufficiently thick to withstand the attacks of predatory fish, crabs and molluscs, the young oysters are very vulnerable. Their chief predators are the fishes *Callyodon* spp., *Acanthopagrus bifasciatus* (Forsskål), *Balistoides viridescens* (Bloch) and the gastropod *Chicoreus anguliferus* (Lamarck).

After the oysters reach the age of one year and a diameter of 7 or 8 cm, the most serious predator is the human shell fisherman. They are now subject to attacks from a number of parasites which, although they seldom cause the death of the oyster, are responsible for a reduction in the value of the shell. The most important of these are several species of red boring sponges, *Clione*, a polychaete worm, *Polydora*, and date mussels, *Lithophaga*. The damage caused by these parasites is most severe on oysters more than four years of age. All these parasites are more common in the deeper water, and in Dongonab Bay about 50% of the shells fished from depths of more than 10 fathoms are unsaleable.

Cultivation Techniques

Spat Collection

All attempts by Crossland to collect spat on the sea bottom on tiles, etc., similar to those used for *Ostrea*, were a failure. He often found spat of pearl oysters on the undersides of marker floats, and above the sea bed on chains holding these floats. This discovery led him to devise floating collectors, suspended a few feet beneath the surface from floats. These were immediately successful and enabled him to collect large quantities of pearl oyster spat. The design of these collectors has now been greatly simplified and is shown in Plate 1, figs. 1 and 2. Twenty shelves of split bamboos are attached in a wooden frame 3 metres in length. CROSSLAND stated that the spacing between the shelves is very critical and that 3 inches gave the best result. After many experiments I have not found the spacing to be so important and distances of 3 to 5 inches between shelves give almost the same average result. After a calm summer the wider spacing yields the best results; the narrower spacing produces more spat after a windy summer. The best average results over six years have been obtained with 4-inch spacing between the centres of shelves.

The date of setting out and the location of the collectors is important. If the collectors are set out during the first half of June, they usually collect great numbers of other Pteriidae but few *P. margaritifera.* On collectors set out during July, the desired species is generally about 90% of the total fixation of all molluscs on the collectors. The lowest part of the collector should be at least 5 metres above the sea bed. Collectors set nearer to the bottom than this yield very few spat. Two collectors, similar in every respect and set out on the same date, one suspended from floats and the other on the sea bed in 10-metres depth directly beneath the former, will result in a total fixation of about 20,000 for the former and usually not more than 10 spat for the latter. CROSSLAND attributes this great difference to the sand rasp which, near the bottom, is stirred up by currents and waves in bad weather. Collectors set near the bottom are very soon covered with a thin coating of silt and the surface is, therefore, not suitable for the attachment of spat. The difference between fixation under artificial and natural conditions is remarkable. On the sea bed directly beneath the collectors, an area of several thousand square metres may be searched carefully without finding a single pearl oyster spat. Because the artificial collectors are near to the surface and thus away from the natural habitat of most predators, the survival rate of spat on them is much greater than under natural conditions.

The first spat are visible to the naked eye six to eight weeks after the collectors were set out. By late October they almost cover the whole of the surface of the bamboo shelves (Plate 2, fig. 3) and, if left any longer on such collectors, overcrowding and consequent stunting would occur. When overcrowding occurs, the byssus ceases to develop and the spat fall off the collectors—such is nature's way of giving them another chance of survival. The total fixation on each collector varies considerably and so far inexplicably, but the type of collector illustrated here usually yields 20,000 spat, the maximum for the past six years being 50,000. Collectors of identical design, but anchored from the end so that the shelves become horizontal, usually result in a greater fixation than on vertical-shelf collectors. So dense is the fixation on the horizontal-shelf collectors that the shelves often have to be taken apart when they are transplanted to the nursery and the bamboos separated, lest stunting should occur. This creates more work so, in practice, vertical-shelf collectors are generally used. Before stunting occurs, i.e. in late October, the collectors are lifted, dismantled, and the spat transferred to the next stage of cultivation.

NURSERY STAGE

By late October the spat are from 1 to 5 cm in diameter and they will now flourish under conditions which would have been fatal to the delicate young larvae at the time of their attachment to the bamboos. They are now able to withstand a fair amount of silt and mud and will grow well on wire-net trays supported 30 cm or more above a silt substrate. But they are still very vulnerable to predatory fish and, if not kept under the protection of wire-netting covers, almost 100% would be destroyed within a month after transfer to the nurseries.

The nursery tray is constructed by fixing five layers of 6-inch square, rigid wire mesh—each layer not less than 40 cm above the other—to teak poles, which are driven into the sea bed (Plate 2, fig. 4). The lower layer is covered with wire-netting of about 2 cm mesh size; thus any spat which fall off the upper layers during transplanting or the subsequent year on the nursery come to rest on this lower layer. The larger mesh of the upper layers allows a freer flow of water and is less costly than small mesh, and the multi-layer trays obviate the necessity of expensive covers for each layer. The optimum spacing for this first year is around 300 oysters per square yard, but in practice the complete shelf of bamboos is placed on the nursery trays, allowing about 50 cm lateral spacing between each shelf. If the fixation on the shelves is particularly dense, the bamboos are separated into clusters of four or five pieces, with about 10 cm between each such cluster. The whole nursery tray is covered very carefully with light gauge wire-netting of 2-inch mesh. During this nursery stage very little attention is required, though periodic inspections are made to ensure that the covers have not become dislodged or torn.

GROWING STAGE

Growing trays are made by supporting a layer of 6-inch square, rigid wire mesh about 40 cm above the sea bed, on iron spikes. Sheets of this wire mesh are fastened to each other, so a continuous tray of any desired length may be constructed (Plate 3, fig. 5). This base is covered with a layer of 1½-inch mesh 16-gauge wire-netting, on which the oysters are planted. The base will probably last for at least ten years, but the wire-netting lasts only three years and is changed with each crop.

After a year on the nursery, the shells are between 5 and 10 cm in diameter and are sufficiently hard to withstand attacks from all but the largest predators. The nursery is then dismantled and the one-year-old shells are taken to the next and final stage of cultivation. They are first cleaned of attached oysters and ascidians, counted into baskets so that the spacing rate on the growing trays can be controlled, and are then planted by divers on the growing trays. A spacing rate of about 50 per square yard has been found to be sufficient to prevent overcrowding and consequent stunting of oysters up to four years of age.

(Stunting can easily be noticed by the reduced length, or absence, of the white spiny growth processes or 'fingers' around the edge of the shell.)

During this growing stage, divers inspect the trays every three months or so to thin out any locally overcrowded areas, and to remove holothurians and predatory muricids. The mortality during this last stage is less than 5%.

After two to three years on such trays the shells are of optimum marketable size, i.e. approximately 5,000 oysters (= 10,000 valves) per ton. After harvesting, the animal matter is removed, the horny non-nacreous margins are chipped off, and the shells are ready for sale to the button manufacturers (Plate 3, fig. 6).

The great advantages of cultivation compared with the fishery of natural stocks are that shells of any size desired by the consumer can be produced, the supply is less dependent on the vagaries of nature and can be regulated to meet the demand and, as has been proved at Dongonab Bay, the natural production of an area can be exceeded many hundredfold.

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EXPLANATION OF PLATES

PLATE 1

Figure 1. Spat Collector with 5-inch spacing between shelves.

Figure 2. Anchoring a Collector. Collectors are suspended from floats and anchored to a mooring chain.

PLATE 2

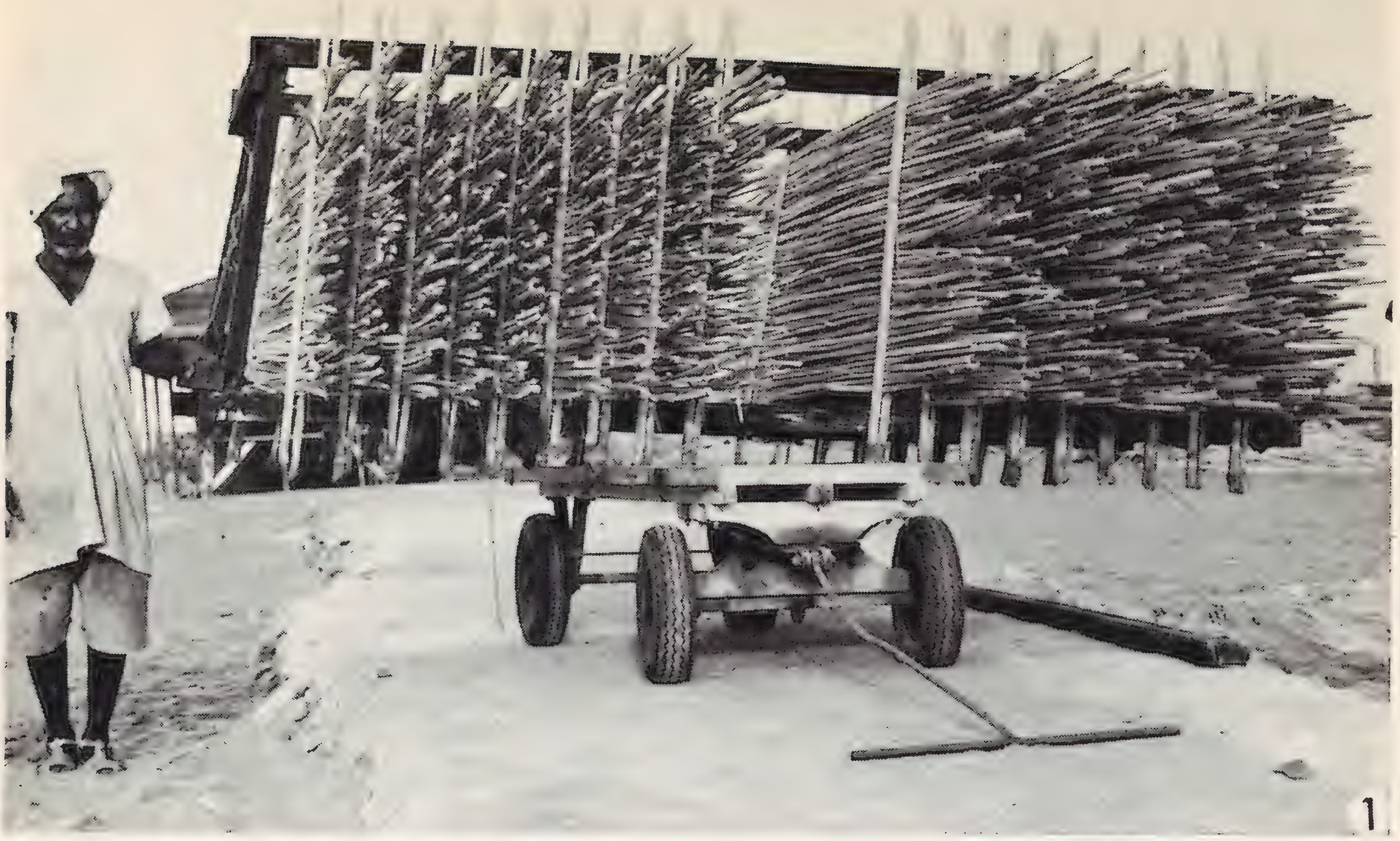
Figure 3. Fixation of spat on part of one shelf.

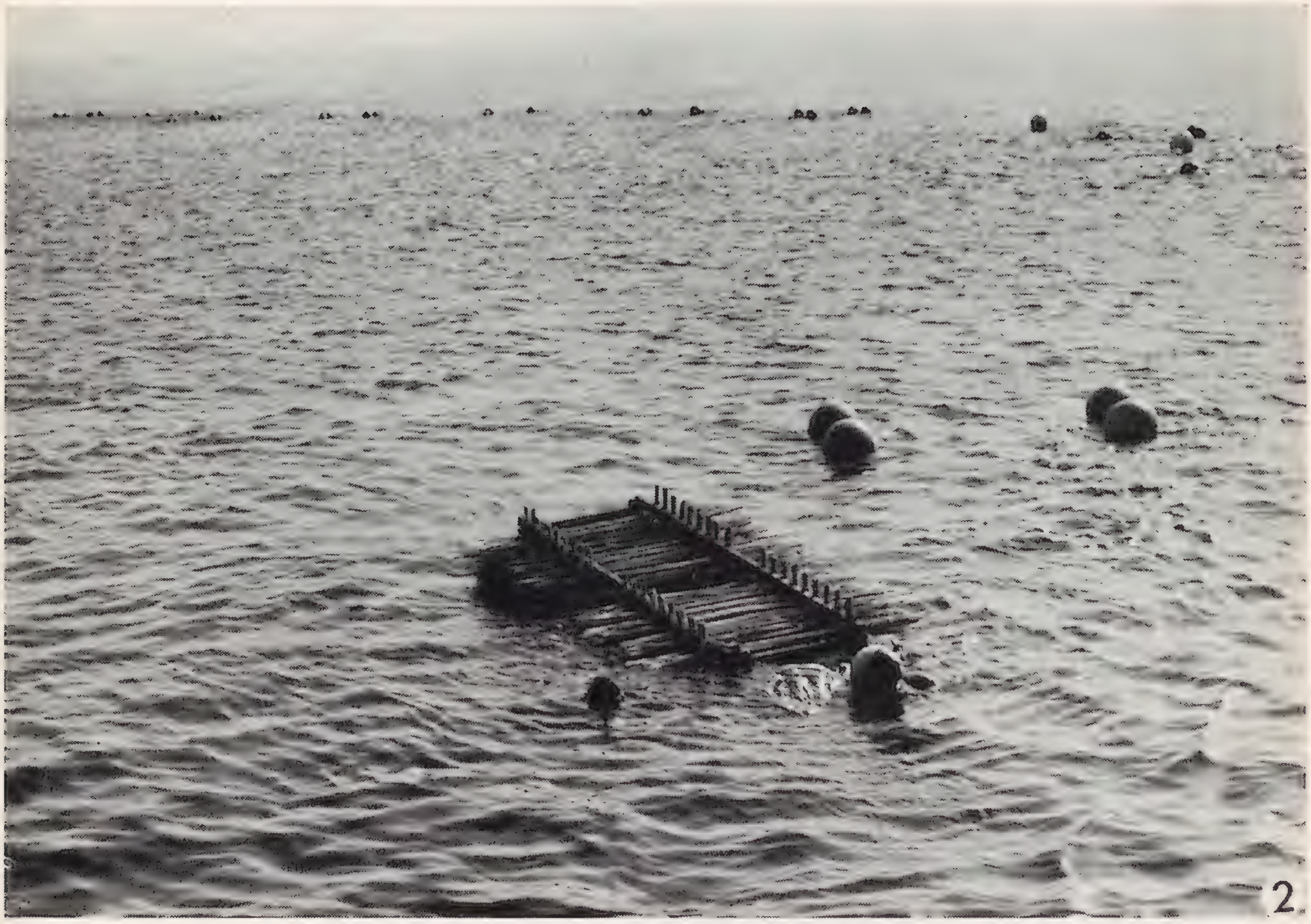
Figure 4. Prototype Nursery constructed on land. The lowest layer is later covered with 1-inch mesh wire-netting and the whole tray is protected from predators by 2-inch mesh covers.

PLATE 3

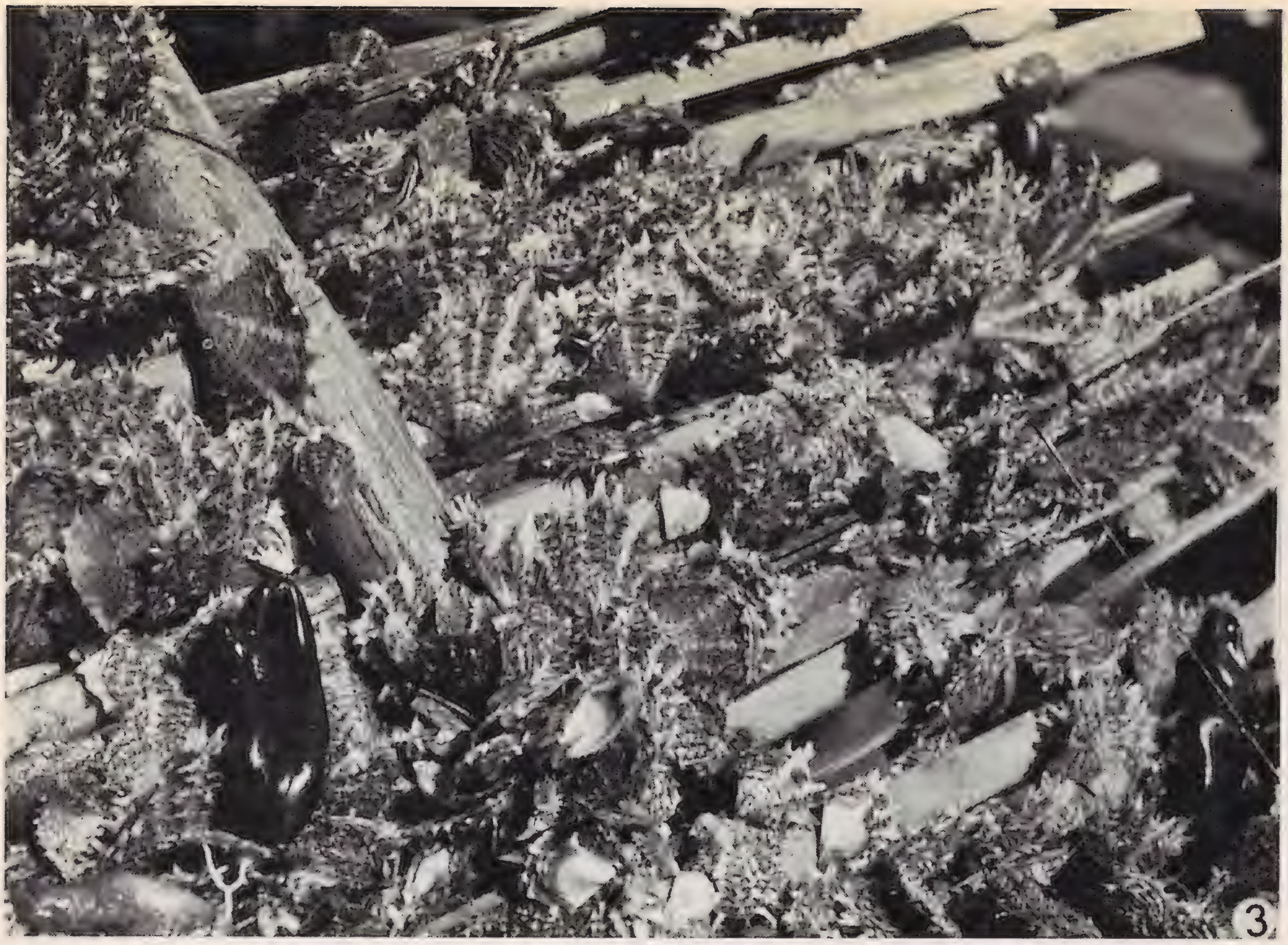
Figure 5. Prototype Growing Tray. In the foreground is shown the type of iron peg used to support the Tray above the sea bed.

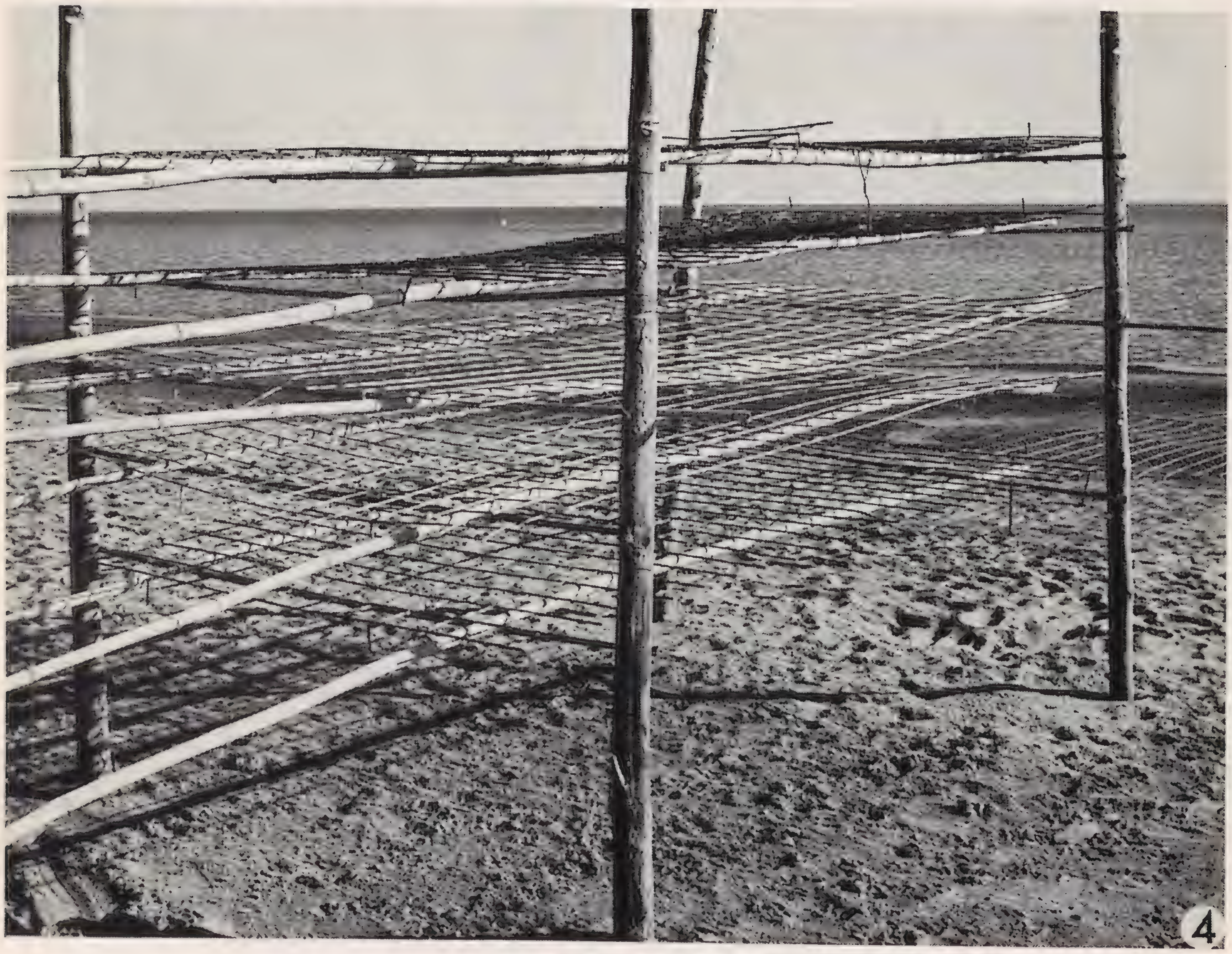
Figure 6. Part of one day's harvest.



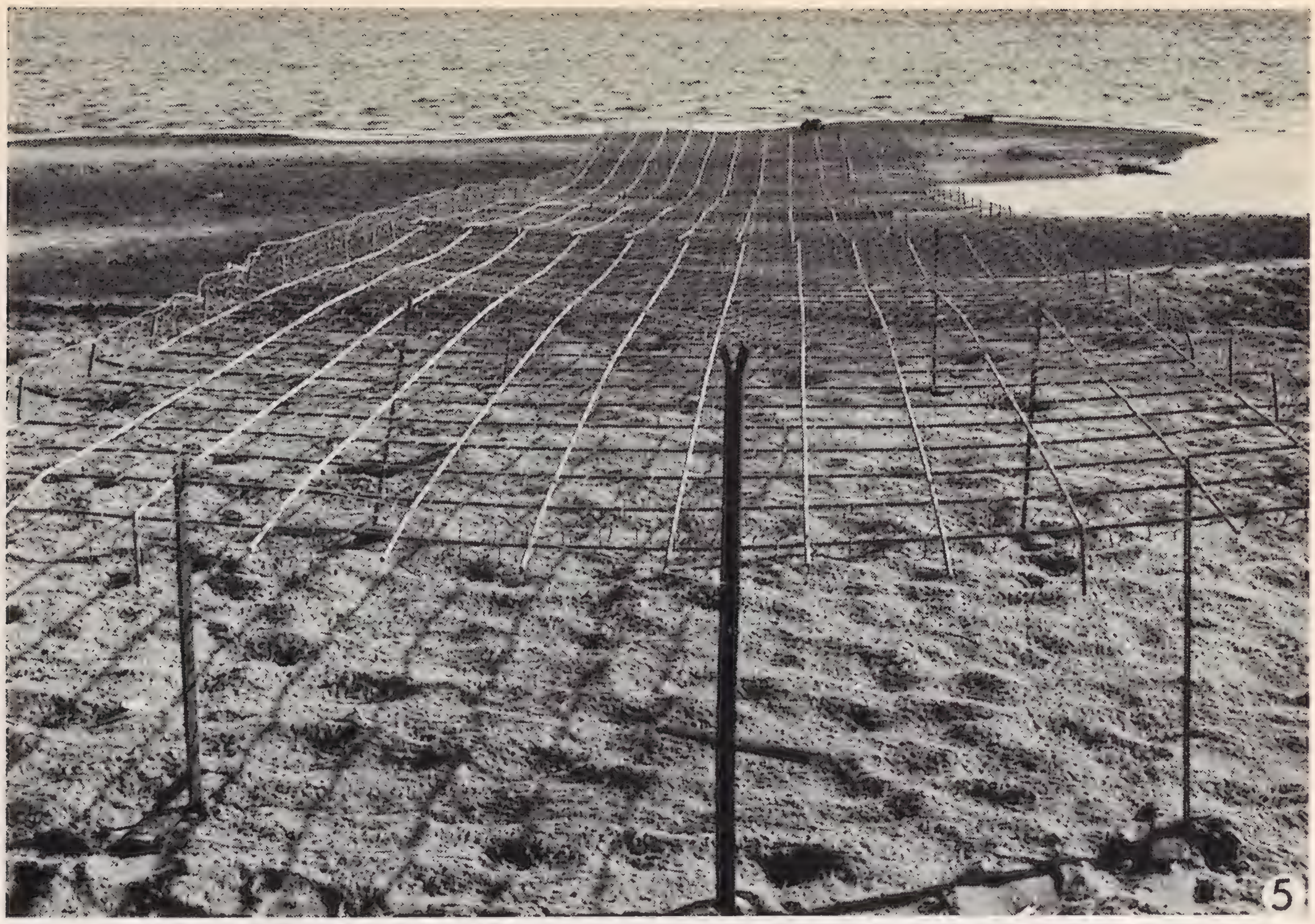


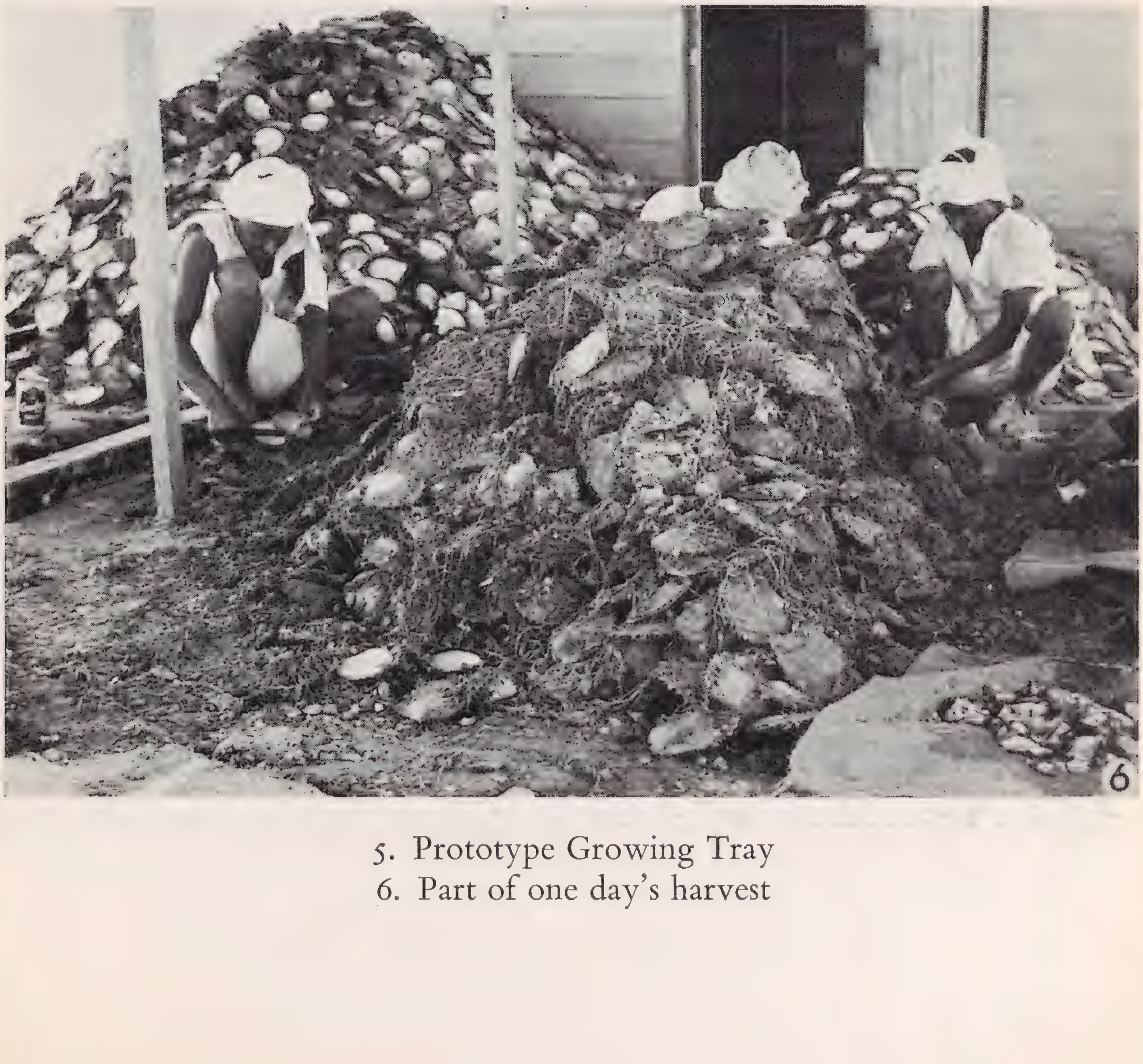
1. Spat Collector with 5-inch spacing between shelves
2. Anchoring a Collector



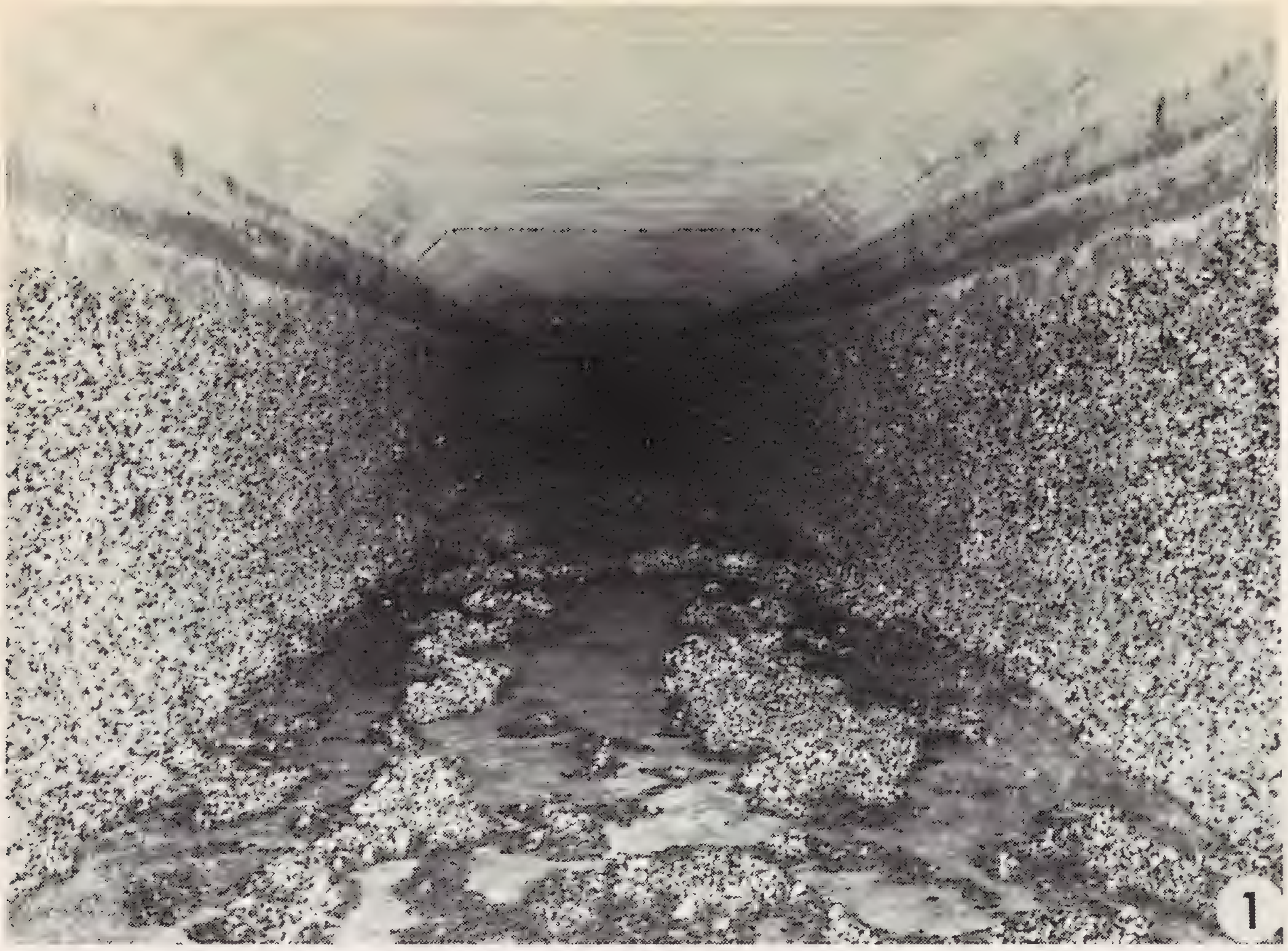


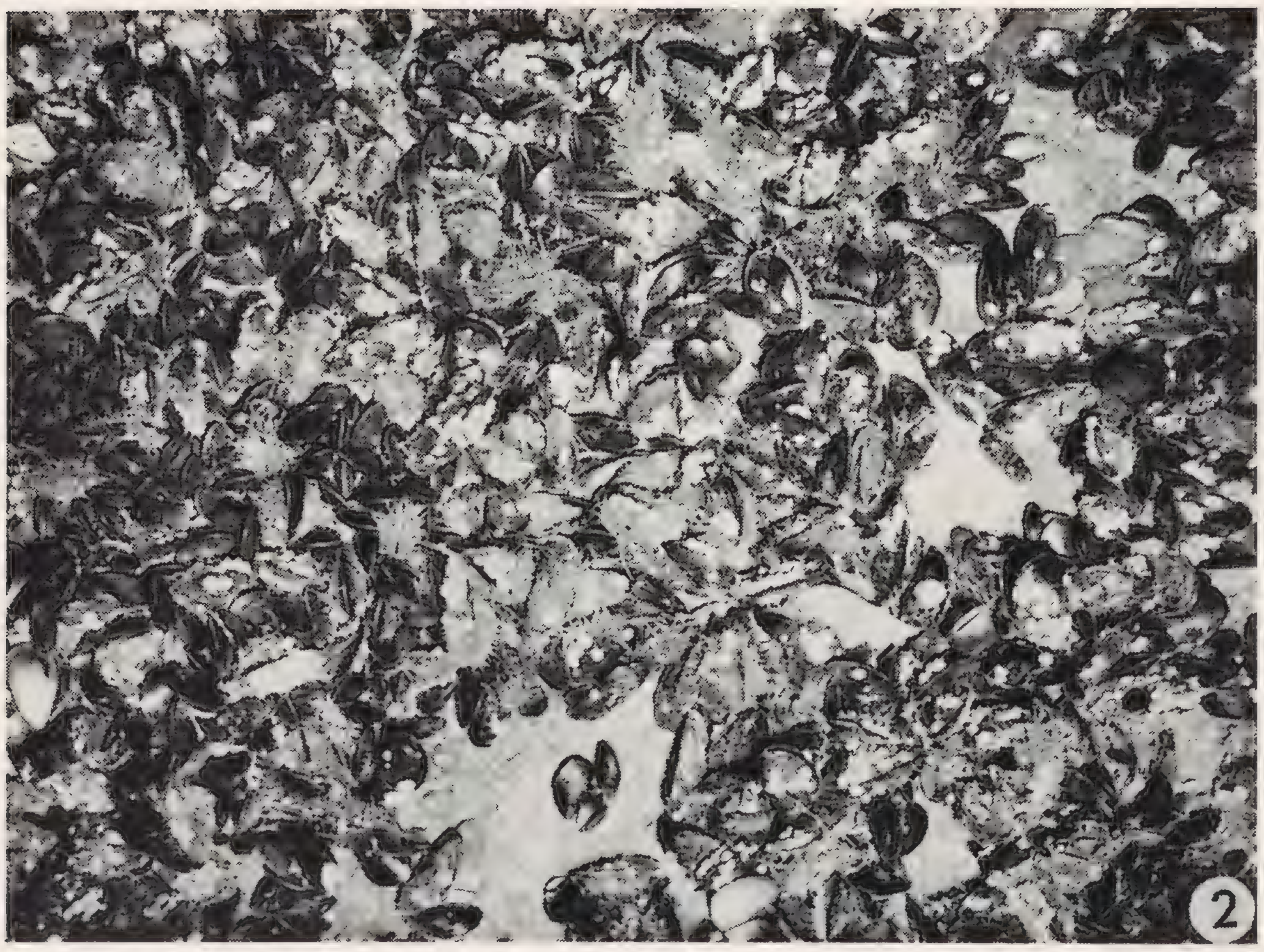
3. Fixation of spat on part of one shelf
4. Prototype Nursery constructed on land





5. Prototype Growing Tray
6. Part of one day's harvest





1. View down the culvert at Brighton 'B' Power Station
2. Close up of fouling on the wall

J. Conch. **26**: 33–38. (1966)

MOLLUSCS FROM A POWER STATION CULVERT

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(*Read before the Society*, 13 *November* 1965)

The cooling water intake culverts of coastal power stations must be among the few marine habitats that are not generally accessible to the conchologist, but recently collections have been made from various power stations during studies of the settlement and growth of fouling organisms. The molluscs listed in this paper have all been found in samples of fouling collected from an intake culvert supplying cooling water to Brighton 'B' Power Station. The samples were taken to study the settlement of the edible mussel (*Mytilus edulis* L.) which grows in large numbers in the culvert. If left unchecked these growths of mussels may cause reductions in the water flow and blocking of condenser tubes which can decrease the efficiency of the power station and consequently increase the cost of electricity generation. The object of the work has been to gain information on the fouling which may be of use in devising control measures. Board & Collins (1965) have described similar work in this field.

The culvert from which the samples were collected (see Fig. 1) is a 10-ft square section concrete tunnel, 398 yd in length, which can pass up to 668 cu. ft/sec. of sea water, the actual amount depending upon the requirements of the station. The velocity of the water may be as high as eight feet per second but, during the period over which samples were taken, there was also a period of several hours each day when the water was static. The water is drawn from Shoreham outer harbour through band screens with a mesh of $\frac{3}{8}$ inch, which exclude all flotsam and large animals, and thus only allow small animals and plankton to enter. All of these organisms pass through the intake pumps. The salinity of the water varies between 27°/₀₀ and 31°/₀₀, the reduction below normal sea salinity level being mainly due to fresh water brought down by the River Adur, which reaches the sea in Shoreham Harbour. Daylight can enter the culvert through access holes covered by metal grids which are situated along the culvert, but in the region from which the samples have been taken there is almost total darkness. The culvert was completely cleared of fouling by station staff in June 1961 (they removed 300 tons of mussels and mud). Fig. 2 shows the density of fouling on the wall at that time. First samples of molluscs were collected during the manual cleaning and subsequently samples of the fouling, including molluscs, have been taken at two- or three-week intervals. Since the culvert is drained only every two years for cleaning, the samples were collected by entering the culvert when the water was static, wearing diving suit and aqualung, the material being scraped from the wall and floor using a paint scraper and collected in a Kilner jar. The samples were initially preserved in 5% formalin in sea water but later transferred to 70% alcohol.

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From the samples of fouling, detailed information on *Mytilus edulis* has been obtained and many records made of the occurrence of other mollusc species. The species recorded are listed below, with appropriate notes, according to the system and nomenclature employed by WINCKWORTH (1932), taking note of the later revisions (1951). Some species of cephalopods and nudibranchs which were prevented from entering the culvert only by the band screens have also been included. The occurrence of those species or genera recorded amongst the fouling is given in Table 1. The first records come from the time of the manual cleaning [24 June 1961], but the variety of species does not really increase until the mussel clumps have established themselves, i.e. in August 1962. Many of the specimens are quite small and it seems possible that some species may enter the culvert either as living adults or as dead shells. Many, on the other hand, must enter as planktonic larvae which settle and grow on the concrete walls or on the shells of other fouling organisms. It is apparent that some species enter and settle in large numbers but mainly die off after a limited period of growth. The many dead shells and the distorted shells of living specimens indicate the large-scale settlement of larvae on to a substrate which is totally unsuitable for the adults. This feature is particularly well shown by those pelecypods which normally have a burrowing habit, e.g. *Venerupis* and *Petricola pholadiformis*.

The collections made from the culvert have provided some 34 species. While these have not been directly compared with the mollusc fauna of the immediate area from which the water is drawn, a comparison has been made with the list of molluscs included in the Sussex Marine Fauna by RICHARDSON (1959). Ten species are additions to this list, viz *Rissoa parva*, *Odostomia* sp., *Leucophytia bidentata*, *Phytia myosotis*, *Venerupis saxatilis*, *Petricola pholadiformis*, *Sphenia binghami*, *Corbula gibba*, *Sepiola atlantica* and *Alloteuthis media*. The occurrence of *Leucophytia bidentata* is interesting as, although the species almost certainly entered the culvert with *Phytia myosotis* as dead shells, ELLIS (1951) gives no previous records for the county of Sussex.

We are grateful to Mr N. TEBBLE and his staff at the British Museum (Natural History) for the identifications that they have made and for confirming some of our own identifications.

Table 1. Occurrence of various mollusc species in samples taken from Brighton Power Station Culvert

	24 vi 1961	24 xi 1961	26 i 1962	5 iv 1962	13 iv 1962	29 iv 1962	8 vi 1962	20 vii 1962	4 viii 1962	24 viii 1962	5 ix 1962	9 xi 1962	28 xi 1962	13 xii 1962	29 iii 1963	25 iv 1963	10 v 1963	24 v 1963	27 vi 1963	18 vii 1963	8 viii 1963
Gibbula cineraria	.	.	.	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	.	.
Lacuna vincta	.	.	.	.	.	.	.	.	.	.	X	X	.	.	X	.	.	X	.	X	X
Littorina littorea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	X	.	.	X	X
L. saxatilis	.	.	.	.	X	.	.	.	.	X	X	X	X	.	X	.	.	X	X	.	.
L. littoralis	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	.	.
Hydrobia ulvae	.	.	.	.	X	.	.	.	X	X	X	X	X	X	X	X	X	X	X	X	X
Rissoa parva	.	.	.	X	X	.	.	.	X	X	X	X	X	X	X	X	X	X	X	X	X
Bittium reticulatum	.	X	.	.	.	.	.	X	X	X	X	.	.	X	X	X	X	X	.	.	X
Odostomia sp.	.	.	.	.	.	.	.	.	X	X	.	X	X	X	.	X	X	X	.	X	X
Crepidula fornicata	X	.	.	X	.	.	.	.	X	X	X	X	X	X	X	X	X	X	X	X	X
Nucella lapillus	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
Buccinum undatum	.	.	.	.	.	.	.	.	.	.	X	.	X	X	.	.	X	X	X	.	.
Nassarius reticulatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	X	.	.	.
Leucophytia bidentata	.	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.	.	.	X
Phytia myosotis	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anomia ephippium	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mytilus edulis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Modiolus barbatus	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.
Musculus marmoratus	.	.	X	.	.	.	.	X	.	X	.	.	X	.	.	.	.	.	.	.	.
Chlamys varia	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lasaea rubra	.	.	.	.	.	.	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.
Cardium exiguum	.	.	.	.	.	.	.	.	X	.	.	.	.	.	X	X	X	.	X	.	.
C. edule	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Venerupis pullastra	.	.	.	X	.	.	.	.	.	.	X	X	X	X	X	X	X	X	X	X	X
Petricola pholadiformis	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mya arenaria	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphenia binghami	.	.	.	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.	.
Corbula gibba	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.
Hiatella sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	X	X	.	.	.

List of Species

Gastropoda

Gibbula cineraria (L.). Mainly as shells on the culvert floor.

Lacuna vincta (Montagu). Shells commonly found, some recently vacated. Lengths of shells up to 5·00 mm.

Littorina littorea (L.). Some juveniles and pieces of adult shells, mostly during the summer of 1963.

Littorina saxatilis (Olivi). Mostly small specimens with shells up to 7·00 mm in length.

Littorina littoralis (L.). Not common; mostly juveniles but a few larger specimens in 1962 and 1963.

Hydrobia ulvae (Pennant). Very common among mussels on the wall and floor of the culvert. Some may have entered as adults with the water flow, but there is likely to be a breeding population.

Rissoa parva (da Costa). Common as living or recently vacated shells. Lengths of shells up to 4·00 mm.

Bittium reticulatum (da Costa). Common; mostly from the floor samples with some living specimens. Shell lengths up to 7·00 mm.

Odostomia spp. Shells are commonly found in the wall and floor samples. No specific identifications have been made.

Crepidula fornicata (L.). Some large specimens over 40·00 mm in length, occasionally with paired males, were collected during the manual cleaning. Some, which obviously had escaped the cleaners, were also collected during 1962. Settlement of spat seems to have been quite extensive in 1962 and 1963, shells of 2·00–3·00 mm in length being recorded in August of those years. There are heavy mortalities of the juveniles, perhaps due to the unsuitable substrate provided by the mussel clusters. Spat which settled in 1961 had a length of 10·00–11·00 mm by the summer of 1962 and 17·00–18·00 mm by the summer of 1963. The largest specimens previously mentioned were on the flat concrete wall and not among the mussels.

Nucella lapillus (L.). Juveniles collected on only two occasions, in 1962.

Buccinum undatum L. Only juveniles found, with shells up to 13·00 mm in length; indicating entry to the culvert by larvae or juveniles and mortality after a short period of growth.

Nassarius reticulatus (L.). Only juveniles found, with shell lengths up to 6·00–8·00 mm in the floor samples.

Aeolidia papillosa (L.). Common on the band screens during late autumn 1964, but not recorded from the culvert samples. Another, unidentified, species was observed in the culvert in September 1962.

Leucophytia bidentata (Montagu). Dead shells found on four occasions in floor samples. These were most likely introduced as shells with the water flow.

Phytia myosotis (Draparnaud). One specimen only [13 April 1962] which probably entered the culvert as an adult, with the water flow.

PELECYPODA

Anomia ephippium L. Some large specimens with shells of 35·00 mm diameter were taken from the walls during manual cleaning in June 1961. No further specimens have been recorded, but during the investigation some settlement may have occurred on the concrete, as only mussel clumps were sampled.

Mytilus edulis L. Settlement times of mussels were found to vary from year to year, being mainly confined to the late summer, though a small settlement was found to have occurred between January and March 1963. The growth of mussels was rapid, some specimens reaching a length of almost 70·00 mm in two years. Some unusual, deformed specimens were found, which have been described by WHITE (1963).

Modiolus barbatus (L.). One specimen only taken from the culvert floor [9 November 1962].

Musculus marmoratus (Forbes). Small living animals or larger shells occasionally found during 1962.

Chlamys varia (L.). Two empty valves were collected from amongst mussels on the culvert floor during the manual cleaning, June 1961.

Lasaea rubra (Montagu). Some specimens from wall and floor samples in 1962 and 1963.

Cardium exiguum Gmelin. Juvenile shells only from the floor samples.

Cardium edule L. Small specimens only from floor samples. Dead shells taken during manual cleaning.

Venerupis pullastra (Montagu). Very common. Of the juveniles which settled after the manual cleaning, few grew beyond 11·00 mm in length, or beyond 16·00 mm in length for the 1962 settlement. Some specimens which survived amongst the mussels grew up to a length of 30·00 mm, but often had deformed shells.

Venerupis saxatilis (Fleuriau). Some amongst the mussels with *V. pullastra.*

Petricola pholadiformis Lamarck. Numerous in samples taken during the manual cleaning. Some adults with deformed shells resulting from growth amongst mussels. No settlement of juveniles observed from later samples.

Mya arenaria L. Only one shell valve of a juvenile, taken during the manual cleaning.

Sphenia binghami Turton. A few living juveniles taken during August and September 1962, from floor samples.

Corbula gibba (Olivi). Only one living juvenile recorded from floor sample [24 August 1962].

Hiatella sp. Occasional living specimens and shells amongst mussels. Shells often deformed.

CEPHALOPODA

Alloteuthis media (L.).* Occurring with the following species, but also observed in the culvert on one occasion.

Sepia officinalis L. Sometimes found on the band screens.

Sepiola atlantica Orbigny. Occasionally taken from the band screens at the entrance to the culvert during the summer months.

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EXPLANATION OF PLATE 4

Figure 1. View down the culvert at Brighton 'B' Power Station, showing the concentration of fouling on the walls and floor.

Figure 2. Close up of fouling on the wall, with *Mytilus edulis*.

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* '*Alloteuthis media* (L.)' of WINCKWORTH and most British authors = *A. subulata* (Lamarck, 1798) non *A. media* (L., 1758)—Editor.

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J. Conch. **26**: 39–41. (1966)

TWO NEW SPECIES OF *HYDROCENA* (NERITACEA) FROM SABAH, BORNEO

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Villa 'De Wael', Noordweg 10, Domburg, Netherlands

(*Read before the Society*, 10 *April* 1965)

Species of *Hydrocena* are not rare in Borneo. In his account of the land and freshwater molluscs of Borneo, MARTENS (1908: 259) mentioned nine species. One other species has been described from the island of Banguey, north of Borneo.

Some of these species are smooth and glossy, others bear thin spiral lirae, but not one has the peculiar triangular scales arranged in spiral ridges as described below, and none has the descending step-like whorls as in *Hydrocena scalinella* n. sp.

Hydrocena scalinella n. sp. (Fig. 1)

DESCRIPTION. Shell small, not very glossy and scarcely transparent, low-turbinate, with 3¼ rapidly increasing turreted whorls. Upper whorls reddish, lower ones reddish-yellow. Embryonic whorl smooth, subsequent whorls with distinct spiral lirae above and below the periphery, which is sharply carinate. The peripheral keel is accentuated by numerous white, triangular scales or flutings. A few other spiral ridges are also provided with scales, but these are less strongly developed. Growth lines weaker than the spiral ridges. Whorls flat—or nearly so—above the peripheral keel, vertical below it, and finally more rounded towards the umbilicus. Suture well marked, somewhat canaliculate in some specimens. Apex rounded, smooth, a little inflated; base at first convex, then concave towards the wide umbilical region. Umbilicus closed by a broad, polished callus. Aperture semicircular, oblique, interior yellow to yellowish-orange. Peristome not continuous; parietal side occupied by the umbilical callus; outer lip sharp, not reflected. Operculum semicircular, calcareous, light-yellow in colour; nucleus eccentric. From the internal surface a short, calcareous peg extends behind the parietal edge of the aperture.

Dimensions (in mm)

	HOLOTYPE	PARATYPES									
Height	2·0	1·9	1·8	1·8	1·8	1·7	1·7	1·7	1·7	1·7	1·6
Maximum diameter	1·6	1·6	1·5	1·6	1·4	1·6	1·5	1·5	1·5	1·4	1·5
Height of aperture	0·9	0·8	0·8	0·8	0·8	0·8	0·8	0·8	0·8	0·8	0·7

Type Locality. Lahad Datu Caves on Teck Guan Estate, Sabah. Holotype and several paratypes, *leg.* Mrs M. Saul, 18 August 1964.

By its peculiar shape, with the step-like, turreted whorls, *Hydrocena scalinella* differs from all the other species of this genus described from Borneo.

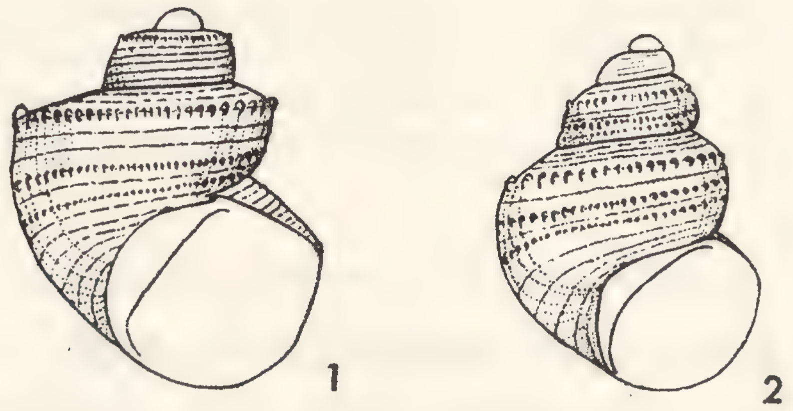

Fig. 1. *Hydrocena scalinella* n. sp. Holotype. Height 2·0 mm, maximum diameter 1·6 mm. Zoological Museum, University of Amsterdam. Type locality: Lahad Datu Caves, Teck Guan Estate, Sabah. **Fig. 2.** *H. saulae* n. sp. Holotype. Height 1·8 mm, maximum diameter 1·4 mm. Zoological Museum, University of Amsterdam. Type locality: Laying Cave, Keningau, Sabah.

Hydrocena saulae n. sp. (Fig. 2)

Description. Shell small, not very glossy and scarcely transparent, turbinate, with 4 rapidly increasing whorls, which are turreted but not so step-like as in *H. scalinella*, and the spire is somewhat more elevated. Upper whorls reddish, lower ones reddish-yellow. Embryonic whorl smooth, subsequent whorls elegantly ribbed by the growth lines and finely striated by the much weaker spiral striae. The carination of the periphery is accentuated by numerous white, triangular scales and, in some specimens, has two or three other rows of scales below it and parallel to it. The whorls are mostly convex, more rounded than in *H. scalinella*. Suture well marked, somewhat canaliculate in some specimens. Apex rounded, smooth, a little inflated; base at first convex, then concave towards the umbilical region. Umbilicus closed by a polished callus which is narrower than in *H. scalinella*. Aperture semicircular, oblique, interior yellow to yellowish-orange. Peristome not continuous; parietal side occupied by the umbilical callus; outer lip sharp, not reflected. Operculum semicircular, calcareous, light-yellow in colour; nucleus eccentric. From the internal surface a short, calcareous peg extends behind the parietal edge of the aperture.

DIMENSIONS (in mm)

	HOLOTYPE	PARATYPES								
Height	1·8	2·0	1·9	1·9	1·9	1·9	1·8	1·8	1·8	1·8	1·8
Maximum diameter	1·4	1·5	1·5	1·5	1·4	1·4	1·5	1·4	1·4	1·4	1·4
Height of aperture	0·7	0·8	0·7	0·7	0·7	0·7	0·7	0·7	0·7	0·7	0·7

TYPE LOCALITY. Laying Cave, Keningau, Sabah. Holotype and several paratypes, *leg.* Mrs M. SAUL, 30 August 1964.

Just as in the preceding species, *H. saulae* bears spiral ridges of small scales. The spire is higher and the whorls are not so step-like. These and other diagnostic differences between *H. saulae* and *H. scalinella* are indicated in the description of *H. saulae.*

In addition to these new species, Mrs SAUL collected a series of *Hydrocena williamsi* (Godwin-Austen, 1889) at the Lahad Datu Caves on Teck Guan Estate, Sabah, 18 August 1964. At my request Mrs SAUL kindly gave the following information about the areas where she collected.

'There are no continuous limestone ranges, and most of the outcrops are within mountains or hills of the other rock. Some of the larger hills contain caves inhabited by swifts. These swifts are a source of edible birds' nests.

'The Laying Cave limestone area is embedded in the mountains of the Crocker Range, N.W. Sabah, which encircle the Keningau plain. After scrambling into the hills for some two and a half miles after leaving the plain, one plunges quite suddenly into a steep ravine of limestone. I do not know how far it extends, but it is quite a small area.

'The outcrop on the Teck Guan Estate at Lahad Datu is in quite low hills only a few miles from the east coast. These outcrops are what I would describe as hills within hills.'

The holotype and a few paratypes of each species were presented by Mrs SAUL to the Zoological Museum of the University of Amsterdam. The other paratypes were returned to Mrs SAUL.

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J. Conch. **26**: 42–46. (1966)

THE STATUS OF *PISIDIUM HIBERNICUM* WESTERLUND

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(*Read before the Society*, 15 *May* 1965)

In his excellent revision of the North American Sphaeriidae, Herrington (1962) includes the European *Pisidium hibernicum* Westerlund in the synonymy of the North American *P. ferrugineum* Prime. In my opinion there are reasons for considering *P. hibernicum* and *P. ferrugineum* as distinct species.

Herrington (1962: 40) states: 'All North American forms are found in Europe, but in smaller number.' His statement suggests equal variation amplitudes of both the American and the European populations. I have, however, seen several extreme forms of *P. ferrugineum* which have no phenotypical counterpart in Europe. The extremely swollen form of *P. ferrugineum* (Fig. 28), the width of which exceeds even the length of the shell, has no analogue in *P. hibernicum*. The oblique form of *P. ferrugineum* (Fig. 21) has no counterpart in Europe, likewise the form of *P. ferrugineum* with prominent tubercular umbones (Figs. 17–20) is not known in *P. hibernicum*. On the other hand, in the large series of *P. ferrugineum* from the United States and Canada which I have had the opportunity to examine, I did not meet with the common equilateral form of *P. hibernicum* with a very short upper side (Figs. 1–6), nor did I find any analogue of the small lake form with a heavy hinge (Fig. 12). The largest form of *P. hibernicum*, which reaches a length of 4·5 mm, is not known to me from America; the largest shell length of *P. ferrugineum* given by Herrington (1962) is 2·4 mm. Although these differences do not necessarily imply specific distinctness, they show the desirability of caution in identifying *P. ferrugineum* with *P. hibernicum*.

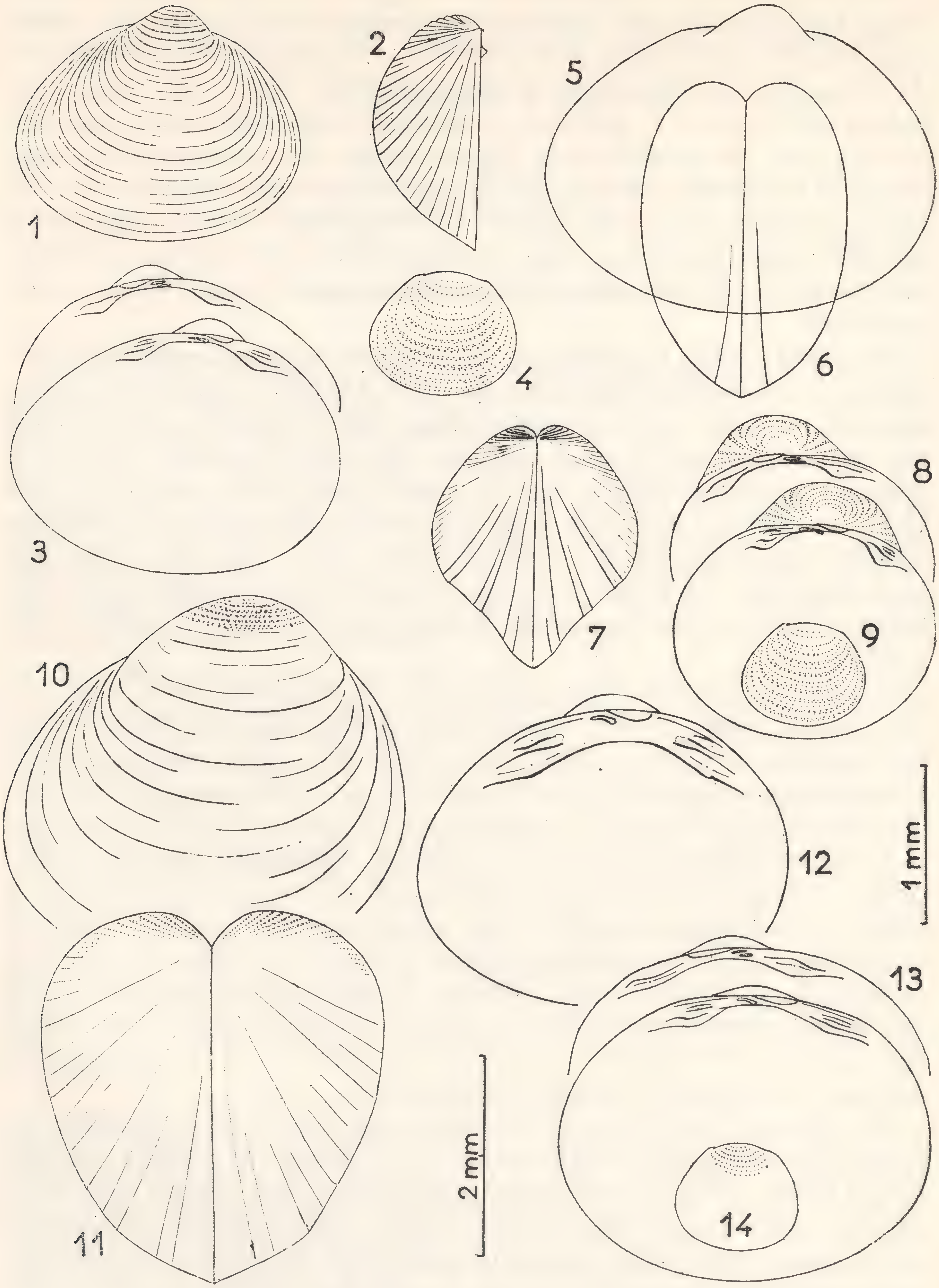
If only adult specimens are studied, the problem is difficult to unravel. The great variability of both *P. ferrugineum* and *P. hibernicum*, as well as the geographical discontinuity in the total area occupied by these undoubtedly closely related species, admits of conflicting interpretations. When the shape of very young shells is taken into consideration, however, two facts become evident: (1) the small degree of variability of juvenile as compared with adult shells; (2) the constant difference between young *P. ferrugineum* and young *P. hibernicum*. This small variability of young shells is familiar to students of *Pisidium*: even the most extreme adult forms are normal when juvenile.

The young shell of *P. hibernicum* is subtriangular. The upper side is short, its length being half the shell length or less. Corresponding to this, the relative hinge length is also very short. The basic form of *P. hibernicum* remains recognizable throughout the ontogenetic development of the shell. In my opinion, the normal adult form of *P. hibernicum* is the form which most closely resembles the basic form. As pointed out by STELFOX (1929), the type form from Lough Nagarriva is extremely aberrant and far removed from the normal form of the species, which he named var. *normalis*. In young shells the short upper side is generally marked by clear-cut edges. In tumid adults, with very broad umbones and rounded outline, the margin is obscured, but usually the short hinge remains perceptible.

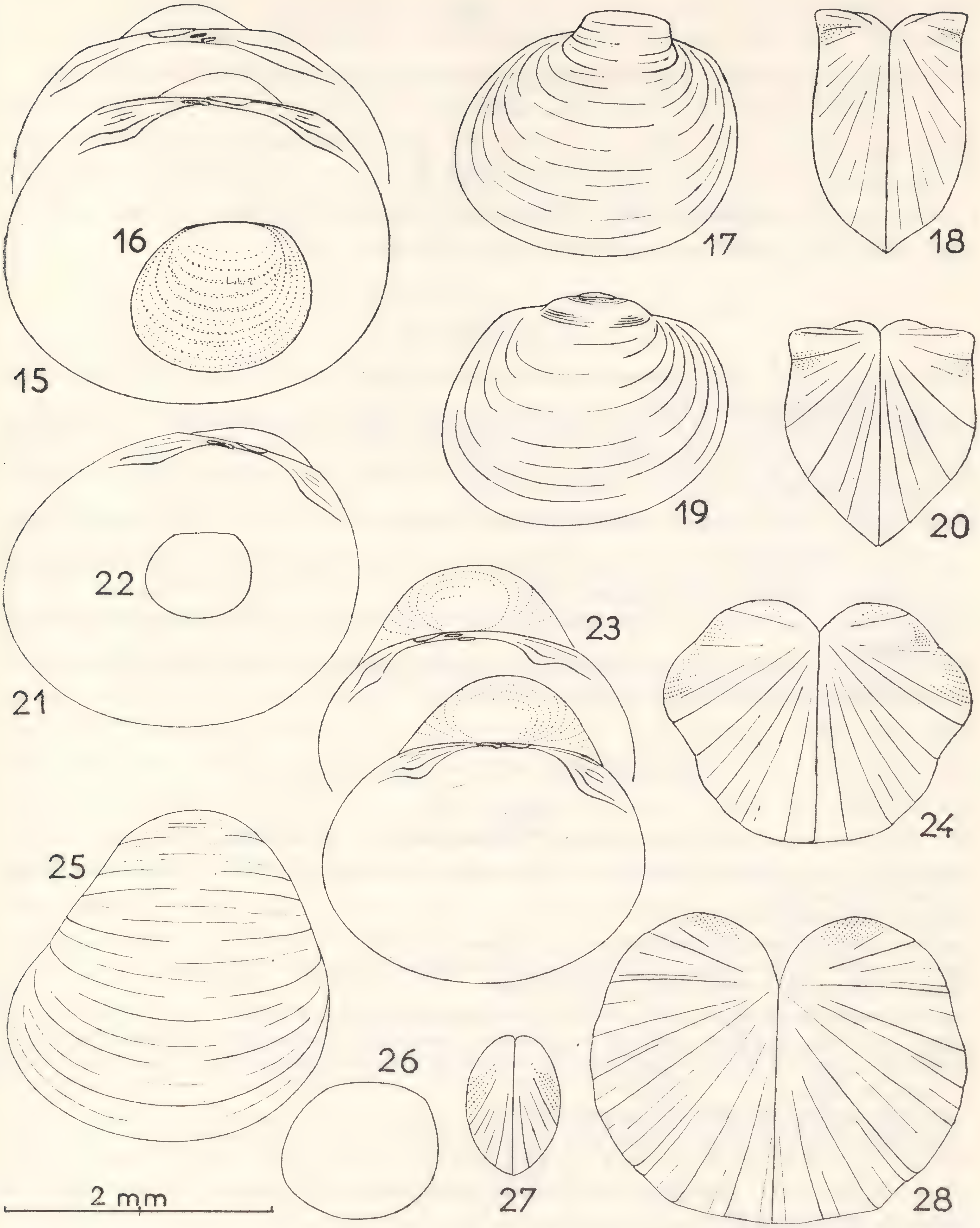
The young shell of *P. ferrugineum*, on the other hand, is subquadrangular. Its upper side is relatively longer than that of *P. hibernicum*, being always more than half the shell length. Its postero-dorsal edge is generally more marked than the antero-dorsal. In adult shells the upper side is generally not sharply defined, but blends gradually with the posterior and anterior margins. In most adults, however, the basic form of the shell remains recognizable. In correlation with the long dorsal margin is a relatively long hinge. Very tumid adult shells of *P. ferrugineum* and *P. hibernicum* can be separated by the difference in hinge length, as well as by the shape of the nepionic part of the shell, if marked off by a growth line.

There is thus a morphological gap between *P. ferrugineum* and *P. hibernicum*. This hiatus, which is more or less visible throughout the whole postnatal development of the shell, indicates that *P. hibernicum* is not merely a form of *P. ferrugineum*, as HERRINGTON maintains. From the evolutionary point of view, the question arises whether *P. ferrugineum* and *P. hibernicum* should be considered as being geographical subspecies or as having attained the status of distinct species. Taking into consideration the fact that the few species of *Pisidium* of which Tertiary fossils are recorded have not changed since the Lower Pliocene, and consequently that evolution in this genus must be very slow, the separation between the American and the European populations must have taken place very early, at least before the Pliocene period. Accordingly, I prefer to consider *P. ferrugineum* and *P. hibernicum* as two distinct species, rather than as geographical races or subspecies of a single Holarctic species.

The limits of distribution of both species have still to be determined. The easternmost locality for *P. hibernicum* known to me is in the Sakhalin peninsula, eastern Siberia. The Palaearctic species *P. pulchellum* Jenyns, which is unknown in America, has been collected in the same locality. The westernmost localities for *P. ferrugineum* are in British Columbia and the North-West Territories (HERRINGTON, 1962: 40). Apparently it is not known from Alaska. An intermediate locality between the North American area of *P. ferrugineum* and the European area of *P. hibernicum* is Iceland. This island is inhabited by some European



Extreme variations of *Pisidium hibernicum* Westerlund



Extreme variations of *Pisidium ferrugineum* Prime species of *Pisidium*, including normal *P. hibernicum*. I do not know any case of associated *P. ferrugineum* and *P. hibernicum*, but transportation by human agency of *P. hibernicum* into the area of *P. ferrugineum* and vice versa may well have occurred. This was perhaps the means of introduction of *P. henslowanum* (Sheppard) into North America and *Sphaerium transversum* (Say) into England.

P. ferrugineum of some European authors (e.g. Zilch, 1960: 23; Boettger, 1961: 242; Koli *et al.*, 1964: 77) is not the American species but the European *P. hibernicum*. The view of Boettger (1961) that *P. parvulum* Clessin in Westerlund (1873) is identical with *P. hibernicum* is, in my opinion, incorrect. I have dealt with this problem in another paper (Kuiper, 1965).

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Explanation of Text-figures

Figures 1–14

Extreme variations of *Pisidium hibernicum* Westerlund

Figures 1–6. Some aspects of the normal form common in European lowland ditches, canals, streams and shallow lakes.

Figure 4. Normal young shell.

Figure 7. One of the many variations of adult diameter profile.

Figure 8. Little swollen form with broad tumid umbones, common in arctic Europe.

Figure 9. Embryonic shell of little swollen form.

Figures 10–11. Large swollen form with tumid umbones, found in Ireland.

Figure 12. Little solid form with very broad hinge, common in Central European prae-alpine lakes.

Figure 13. Large ovate form with thin shell, occurring in some high mountain tarns in the Pyrenees and the Alps.

Figure 14. Embryonic shell of large ovate form.

Magnification: Figs. 1–9, 12—scale of 1 mm, Figs. 10, 11, 13, 14—scale of 2 mm.

Figures 15–28

Extreme variations of *Pisidium ferrugineum* Prime

Figure 15. Normal form.

Figure 16. Young shell of normal form.

Figures 17–20. Form with tubercular umbones.

Figure 21. Oblique form.

Figure 22. Embryonic shell of oblique form.

Figures 23–25, 28. Extremely swollen forms, the width exceeding the shell length.

Figures 26–27. Young shells of the swollen form.

Magnification: Figs. 15–28—scale of 2 mm.

J. Conch. **26**: 47–48. (1966)

ARIANTA ARBUSTORUM (L.) LIVING WITH *HELIX NEMORALIS* L. ON BLOWN SAND

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(*Read before the Society*, 13 *March* 1965)

Arianta arbustorum (L.) is generally considered a woodland or hedgerow species, but sometimes in the far north of Scotland it lives on blown sand. Such occurrences are sufficiently rare (see Stratton, 1954) to render the discovery of a new locality noteworthy and, therefore, it is pleasant to record that in June 1964 I found the species living on blown sand on Islay, Inner Hebrides.

Islay, the most southerly and one of the largest of the Inner Hebrides, contains considerable areas of blown sand and these proved most interesting. The Rhinns of Islay—of pre-Cambrian grits, slates, and gneisses—form the island's western portion, and on the western coast are the fine dunes of Machir Bay and Lossit Bay. The Machir dunes are very extensive and rise to a hundred feet above sea-level; they are well-vegetated, with plenty of primroses in places. *Helicella itala* (L.), *Arianta arbustorum* (L.), *Helix nemoralis* L. and *H. aspersa* Müller (the last-named sparingly) all live together on them, both on the inner well-vegetated dunes and also on the outer marram-covered ones. This is, apparently, a unique concomitance of species: *Arianta* lives on blown sand associated with *Helix hortensis* Müller, *Helicella itala* and, rarely, *H. caperata* (Montagu) in a few localities in Caithness (Peach, 1884; Oldham, 1929) and west Sutherland (Boycott & Oldham, 1936), but nowhere else so far as I have ascertained.

Oldham (1929), after discussing the occurrence of *Helix hortensis* [sub nomine *Cepaea*] and *Arianta arbustorum* on blown sand, concludes:

'The object of this paper is to inquire: (*a*) Whether, and, if so, under what circumstances, *A. arbustorum* or *C. hortensis* live on blown sand anywhere within the geographical range of *C. nemoralis*; and (*b*) if so living, is *C. nemoralis* actually associated with either or both of them. If, as has been suggested, *nemoralis* is better fitted than the other two for life on blown sand, its advantage would decrease as it approached the northern limit of its range and ultimately would be neutralized by their greater capacity for withstanding cold, or by whatever the cause is that enables them to outdistance their rival.'

It is now possible to answer both questions in the affirmative, for *Arianta* lives on blown sand at Machir Bay, Islay, well within the geographical range of *H. nemoralis*, and the two species are in association throughout these dunes. *H. hortensis*, incidentally, has not been recorded from Islay nor did I find it there.

At Lossit Bay, also on the western coast of the Rhinns, only the landward fringe of the dunes was examined. Shells of the four species found at Machir Bay were abundant, but very few living specimens were seen. Conditions were closely similar to those at Machir Bay and probably all the molluscs live farther down the dunes. Both *Arianta* and *H. nemoralis* were also taken on the cliffs of the Rhinns. In the dunes at Ardnave Point, on the north coast, a single half-grown *Arianta* shell was picked up, but no living examples were obtained, nor was *Helix aspersa* seen. In the eastern part of Islay the dunes along Laggan Bay, which faces west across Loch Indaal to the Rhinns, yielded no *Arianta* nor *H. aspersa*, alive or dead. Possibly investigations on some other of the larger Inner Hebrides (Mull, Skye ??) might yield a similar association of species on blown sand.

A list of the non-marine Mollusca of Islay will be published in the *Glasgow Naturalist.*

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J. Conch. **26**: 49–50. (1966)

PHYSA ACUTA, AN INTRODUCED SPECIES NEW TO SOUTH AFRICA

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(*Read before the Society*, 15 *May* 1965)

A number of years ago Dr A. D. J. MEEUSE, then at Pretoria, collected a sample of freshwater gastropods, which he subsequently passed on to the author of this note. Only recently were these specimens subjected to a detailed examination which, however, proved inconclusive. It appeared that the material belonged to the genus *Physa*, but the species could not be established. Thanks to Dr W. J. CLENCH of the Museum of Comparative Zoology at Harvard University (Cambridge, Mass., U.S.A.), the snails in question were finally identified as *Physa acuta* Draparnaud, 1805. This species appears to be new to the South African list (CONNOLLY, 1939) and it is thought of sufficient interest to be put on record.

The original specimens were collected by Dr MEEUSE in 1957 in Pretoria, at the Fountains Valley, in shallow water with a slight current. In February 1965 the writer was able to make a hasty search for the species and finally tracked it down to the little dam wall at the confluence of the two streams near the tortoise enclosure, where five small specimens were collected. The Fountains Valley, south of Pretoria, has for long been protected as one of the city's sources of water. Nowadays it is a favourite picnic spot amidst beautiful surroundings; the water (various streams, dams and ponds) is shallow and clear with a very slight current. It harbours very few molluscs, probably mainly on account of the presence of numerous waterfowl.

Up to the present, few introduced mollusc species are known from Pretoria (cf. VAN BRUGGEN, 1964: 164—*Vallonia pulchella* (Müller), *Zonitoides arboreus* (Say), *Limax flavus* L., *Helix aspersa* Müller, and the species under consideration as an 'unid. spec.'), but it is certainly not surprising to find a new introduced species; modern Pretoria is a large and populous centre with rail, road and air connexions throughout the country. It is extremely difficult—indeed purely guesswork—to establish where and how *Physa acuta* has gained a foothold in Pretoria. *P. acuta* was originally widely distributed around the Mediterranean and in southern Europe; subsequently it has established itself in western, central, northern and even eastern Europe, partly as a consequence of the activities of aquarists and pondkeepers. It has proved an adaptable species which has been found both in greenhouses and in the open air under greatly varying climatic conditions. Apart from accidental importation with water-plants, migratory birds might also have played a rôle in transplanting this Palaearctic species to sub-Saharan Africa. In this respect it is interesting to mention here another record of *Physa acuta* in sub-Saharan Africa, viz at Kampala, Uganda*; the species is not mentioned in MANDAHL-BARTH's extensive revision of the freshwater molluscs of Uganda (MANDAHL-BARTH, 1954), and consequently Kampala is a **new record**. Both Kampala and Pretoria are situated on the main migration routes of many European bird species, which might probably explain the presence of *P. acuta* in both localities. The Pretoria material has been incorporated in the collections of the Natal Museum [Mollusca nos. 4156, 4157], while some duplicates of the original sample have been retained in the Museum of Comparative Zoology, Harvard.

APPENDIX

Physa acuta has a sinistral shell and thus may be confused in South Africa with species of the freshwater genus *Bulinus* Müller s.s. of the family Planorbidae. Therefore a short comparative description is appended (see also VAN EEDEN, 1960).

	Physa acuta	*Bulinus* s.s.
SHELL	smooth, glossy, translucent	dull and opaque
	umbilicus completely closed	usually rimate
ANIMAL	mantle lobes overlap shell	no mantle lobes
	no pseudobranch	pseudobranch present
	transverse rows of radula V-shaped	tranverse rows of radula more or less straight

Some other characters such as shape of the columella, convexity of the whorls (in *Physa acuta* usually flat, while those of *Bulinus* are frequently very convex), etc., may be of use, but are subject to the usual variation which accounts for the difficulty of separating taxa in freshwater molluscs; significant anatomical differences will, of course, be revealed by dissection.

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* Dr W. J. CLENCH *in litt.* Material in the Museum of Comparative Zoology, Harvard University.

J. Conch. **26**: 51. (1966)

THE DISTRIBUTION IN IRELAND OF VERY DARK FORMS OF *COCHLICELLA ACUTA* (MÜLLER)

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(*Read before the Society*, 15 *May* 1965)

The shells of *Cochlicella acuta* (Müller) can be divided broadly into two colour-groups. The typical form has a fawn or sand-coloured shell, streaked with white, and often with a single dark band near the base of the body-whorl. The second form comprises the varieties *bizona* Moquin-Tandon and *flammulata* Bourguignat, and is heavily marked with two black bands or the shell may sometimes be almost entirely black.

The distribution of the two forms in Ireland is interesting. The dark form is confined to the eastern coast from Co. Wexford north to Ballycastle, Co. Antrim, and along the northern coast as far as Portstewart, Co. Londonderry; this appears to be its northern limit in Ireland, but how far west it may occur along the Waterford–Cork coast we do not know*—on this south coast sandy coastal areas are few and isolated. Jeffreys, however, records var. *bizona* from 'Cork' [no doubt Co. Cork] (*British Conchology* **1**: 234 (1862)).

Elsewhere in Britain this form appears to have mainly a western and south-western distribution, reaching as far north as Bispham, Lancs. The darkest shells we have seen are from Poolvaish, Isle of Man, where they were abundant. Jeffreys also records var. *bizona* from Iona, in the west of Scotland, but we have no confirmation of this record. In Islay (about 40 miles south of Iona) only typical specimens were taken in 1964 [by N. F. McM.].

This distribution suggests that the dark form is a recent immigrant into Ireland, as compared with the typical form. A somewhat similar dark form of *Helicella virgata* (da Costa) has a similar but more restricted range and does not reach as far north as Co. Down. The area occupied by *Theba pisana* (Müller) is restricted to an even shorter stretch of the eastern coast. [I have long suspected that this may have been introduced as food by settlers on the Dublin coast.—A.W.S.]

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* Mr T. E. Crowley (*in litt.*) informs us that the pale form occurs at Kinsale.

J. Conch. **26**: 52–65. (1966)

MARINE MOLLUSCA FROM MALTA

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(*Read before the Society*, 16 *January* 1965)

Introduction

This paper is the result of work carried out on the Imperial College Expedition to Malta in 1961. The main purpose of the expedition was to carry out a programme of marine archaeology, but the biologists in the team also planned a short marine ecology programme. It seemed that random collecting of marine fauna and flora would achieve little of scientific value, especially as workers at the British Museum (Natural History) had indicated that most specimens in collections had minimum data, most having been dredged or found in shallow water. In view of this it was decided to modify the well-known transect methods, which are used for studying zonation on the sea shore, for work under water. A satisfactory modification having been devised, it was then possible to obtain the useful scientific data required. As the results show, relevant information such as ranges of depth, temperature and light intensity could be measured for any species occurring regularly in a transect. The transect method was as follows:

A weighted line was dropped close to the submarine cliff face selected for transect. The sampling depths were marked off on the line at exponential intervals. The upper end was attached to the rocks above the surface upon which an indicator mark had been painted, thus enabling divers to return to the exact point on later occasions. A profile of the submarine cliff was then plotted with the help of depth gauges, rules and inclinometers (Fig. 1). The diver sampled at the required depths by scraping off into bags the entire fauna and flora from an area of 100 cm². This area was measured by means of a bronze

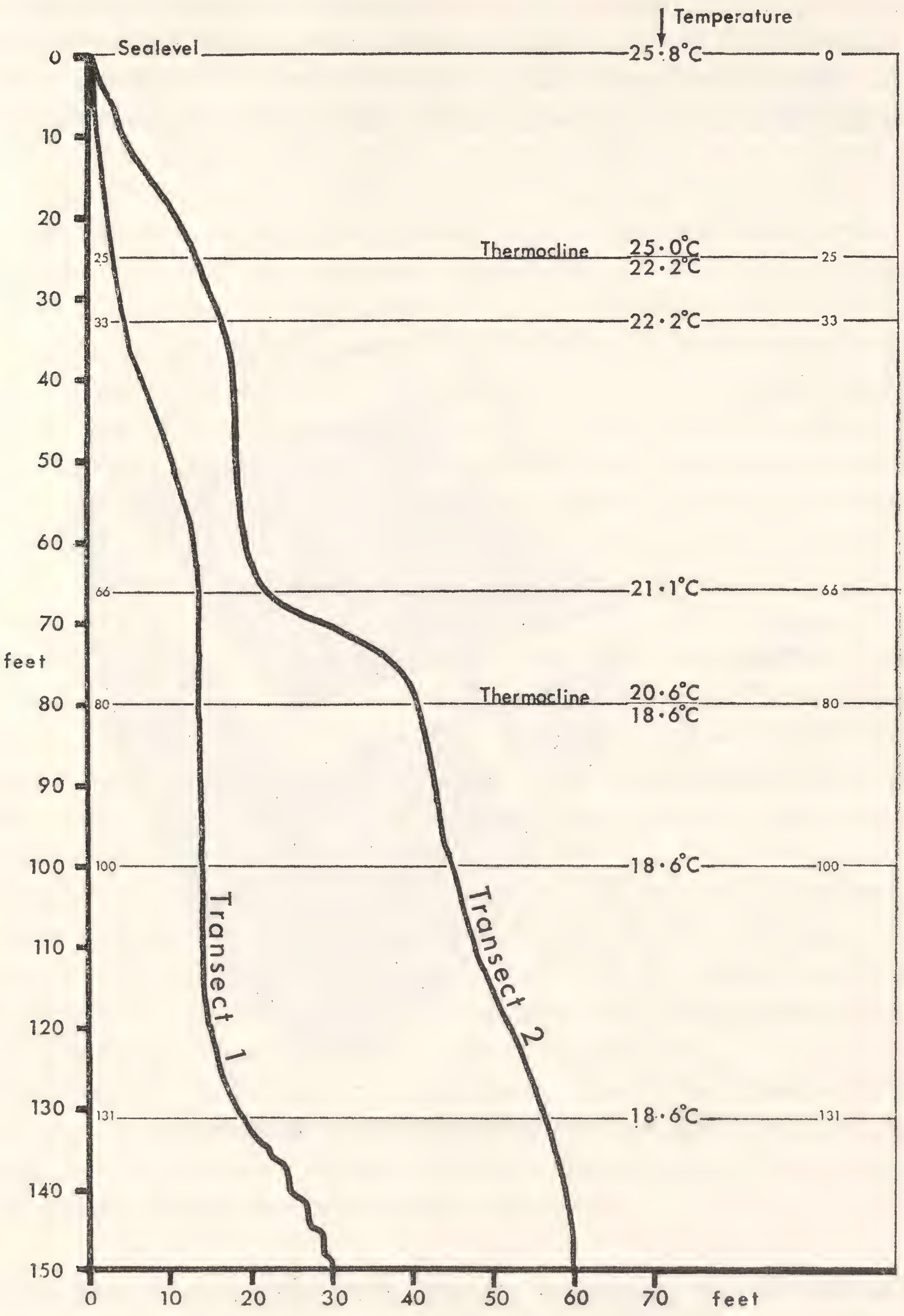

Fig. 1. Profiles of Transects 1 and 2.

quadrat to which the bags were attached as shown (Fig. 2). One side of the quadrat was sharpened to form a scraping edge and this, with the help of a 1½-inch cold steel chisel, was used to scrape the living organisms from the rock face. The bags were of a special design, made of scrim, with elastic necks for attachment to the quadrats. The mesh was wide enough to allow free flow of water and yet small enough to prevent organisms escaping. Pegs closed the bags when removed full from the quadrats; thus the specimens from each quadrat could be collected in separate bags which, if fastened to a waist belt or a line, enabled one diver to collect several samples before returning to the surface.

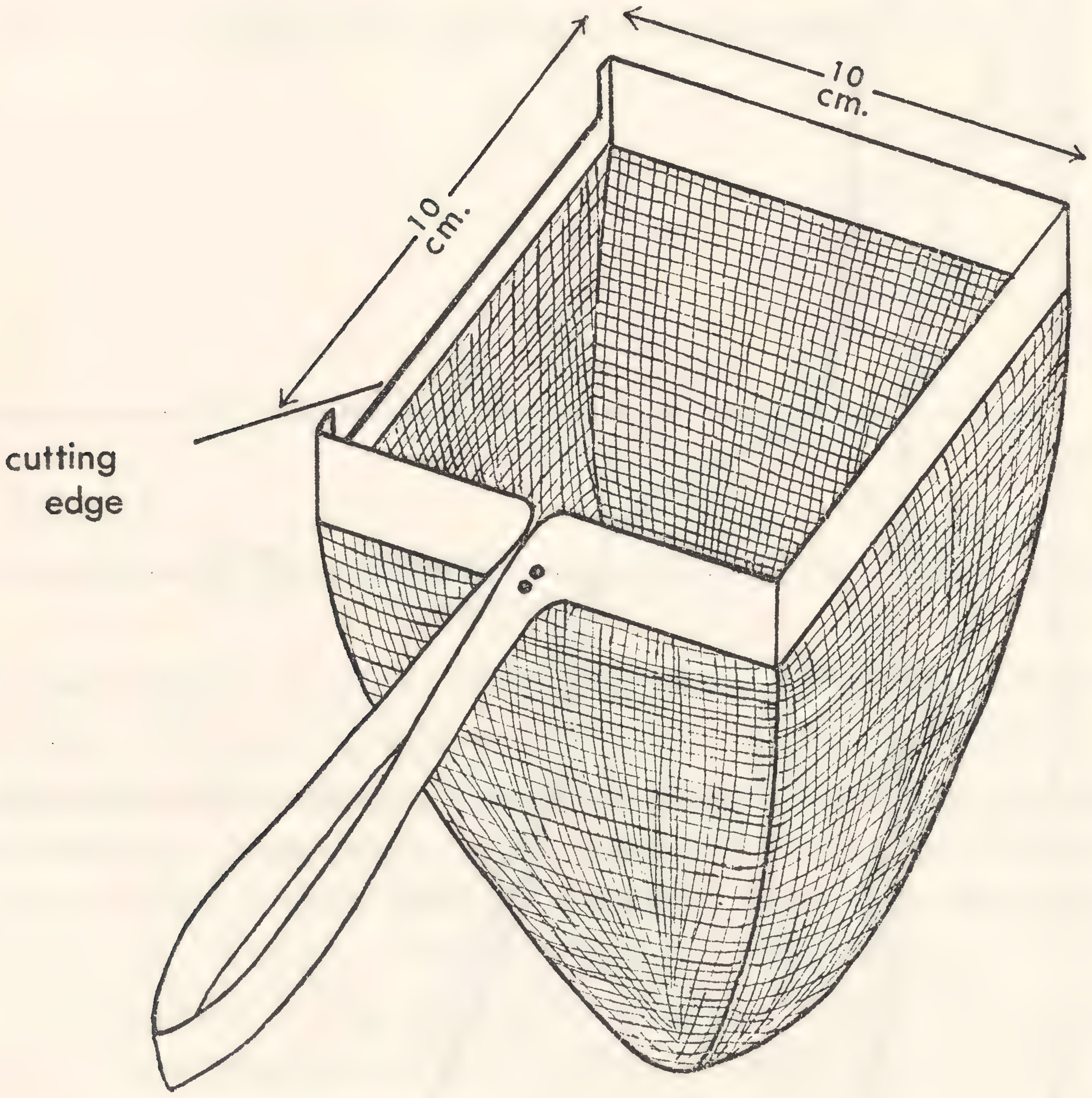

Fig. 2. Bronze quadrat with scrim bag attached.

In Transect 1, four quadrats of 100 cm² were taken at each level on the line. The quadrats were placed one at each corner of a square of length 2 m whose centre was on the depth marker of the transect line. In Transect 2 a larger sample was required so four contiguous quadrats were taken starting at each corner of the 2 m square, thus totalling sixteen quadrats each of 100 cm^2. The diver, therefore, had no choice and would not be disposed to choose a particularly lucrative area for sampling. The transect information was supplemented by on-the-spot observations made on underwater drawing boards. Special attention was also paid to species which could not be collected, to upper and lower limits of distribution of the more distinct species, and to densities of population. When the sample bags reached the surface, large individuals were sorted and identified in the boat, but most of the preliminary identification and assessment of abundance was carried out in the laboratory. Distribution and abundance were calculated by counting the numbers present per quadrat or by calculating %-area or %-weight of a species in each quadrat. Representative specimens of each species were preserved and fully identified as given below (Tables 1–3).

This paper deals with the molluscan fauna taken in two transects some 300 yards apart, but of similar aspect, on the coast of Malta at Wied iz-Zurrieq, slightly east of the Blue Grotto. Here the high cliffs fall almost vertically beneath the sea to a depth of 27 m (90 ft), where the cliff gives way to large boulders and fallen debris which form a scree slope before reaching the bottom at 45 m (150 ft). As will be seen from the results, no large Mollusca were found on the steep submarine cliff, possibly because they were too heavy to hold on to the algae or to the cliff. [In Sicily, the following year, gently shelving profiles were selected for underwater transects and a higher proportion of larger specimens was found.]

Mr A. Larkum, who was responsible for the algal identifications, collected algae by a similar method on the Azores Expedition in 1959. These results show a comparison between the distribution of algae and molluscs. Less correlation was found between the distribution of algae and herbivorous molluscs than was expected. Much more information on this subject is required, however, before any definite conclusions can be reached.

This paper also considers the Mollusca found in or on amphorae brought up from three Roman wrecks sunk off Xlendi some 2,000 years ago and now lying at 70 m (230 ft). Many of the empty shells had, presumably, been washed into the amphorae or been carried in by animals such as octopuses which often inhabited amphorae containing large numbers of shells.

Material was also collected at random from around the coast of Malta and the west coast of Gozo down to a depth of 70 m (230 ft) and in transects made at Xlendi, on Gozo Island, where the archaeological programme was carried out. This is dealt with in the final section of the paper.

Mollusca from the Transects

The general aspect of the habitat and methods of collecting have been described [by C. W.] above by way of introduction to the more detailed study of the Mollusca. Firstly it should be remembered that these slopes off the shore of the Maltese Islands are almost all of steep, metamorphosed limestone. This means that the chance of getting large species is small. From the list of species it is evident that all are small species or the juveniles of the commoner large species, for only these could maintain a foothold long. The largest shell taken was a juvenile *Fasciolaria lignaria* (L.) [in Transect 1 at 10 ft] measuring 18·8 mm in height and consisting of only 5½ whorls. The largest of this species taken elsewhere by the expedition measures 43·1 mm in height and has about 7 whorls.

The above facts may explain why it has been somewhat difficult to be sure of the identity of some of the shells collected, and these have not been included in the lists. There are twenty-six specimens in this category, but as this is only about 14% of the total the general facies of the tables is not affected very much. Again, it has been difficult to be sure just how many of the shells were dead when collected. Some certainly were, but it has been assumed that the pattern of the species at any given level is not affected by the fact that some were dead and some alive.

A total of 157 shells have been named (Table 1). There are no bivalves, as is to be expected, and some of the commoner Mediterranean species one would have expected to find are absent—notably *Pisania maculosa* (Lamarck), which species was taken by the expedition in fair numbers at other more inshore habitats. Its absence from the transects may be due to the fact that it is a comparatively heavy shell for its size.

An attempt has been made to show the correlation of the Mollusca and the algae with slope of the rock face and temperature (Tables 2–3 and Fig. 1). Those who worked on the algae report a strong intrusion of green algae on browns at 40 ft and an increase in red algae. Can this in any way explain the large number of molluscan species at this level in Transect 1? Here we have 12 species represented by 46 specimens, i.e. 66·6% of all the Mollusca taken in the transect. The next most occupied level is at 60 ft, where 7 species are represented by 9 specimens; in Transect 2 at the same level we have 14 species and 26 specimens, i.e. 30% of the total for the transect.

The absence of Mollusca from Transect 2 at 40 ft is, we suggest, simply due to an error in collecting or storing specimens, as the algal coverage seems to be the same in its variety as in Transect 1. This is unfortunate, as it would have made a very interesting comparison with the other transect at the same level, the former sloping gradually down whilst the other profile has a ‘shoulder’ in it. We must also notice the less steep gradient in Transect 1 between 30 ft and 40 ft, at which level the divers report a lot of bare rock with much animal life and a low algal coverage.

General Notes on the Species

The commonest species is *Columbella rustica* (L.), represented by 30 specimens

Table 1. List of species of Gastropoda from the two transects in order of frequency

SPECIES	TOTAL NUMBER COLLECTED	NUMBER OF OCCURRENCES
Columbella rustica (L.)	30	9
Rissoa variabilis (Mühlfeld)	20	4
Vexillum ebenus (Lamarck)	15	7
Gibbula turbinoides (Deshayes)	11	7
Calliostoma conulus (L.)	10	3
Bittium reticulatum (da Costa)	9	6
Chauvetia brunnea (Donovan)	8	6
Conus mediterraneus (Bruguière)	7	4
Nassarius incrassatus (Ström)	6	3
Bittium lima (Bruguière)	5	1
Murex ?cristatus Brocchi var. *inermis* Philippi	4	4
Alvania cimex (L.)	4	2
Diodora apertura (Montagu)	3	2
Cantharidus exasperatus (Pennant)	3	2
Alvania montagui (Payraudeau)	3	2
Mitrella scripta (L.)	3	2
Triphora perversa (L.)	3	1
Fasciolaria lignaria (L.)	2	2
Homalopoma sanguineum (L.)	2	2
Patella lusitanica Gmelin	2	1
Mitrella savignyi (Payraudeau)	2	1
Emarginula elongata O. G. Costa	1	1
Calliostoma granulatum (Born)	1	1
Clanculus jussieui (Payraudeau)	1	1
Rissoina bruguieri (Payraudeau)	1	1
Cerithiopsis metaxae (Chiaje)	1	1
26 species	157	

occurring from 5 ft to 60 ft but not below. DESPOTT (1919) reporting on the Mollusca of Marsascirocco Harbour, not far from the present area, says of this species: 'most abundantly dredged on weedy bottoms at a depth of 1 to 12 fathoms or more'. It seems that this species inhabits the upper levels. As it is a very common shell throughout the Mediterranean, it is only to be expected that it would show up as the commonest in the transects. But *Conus mediterraneus* Bruguière is also a very common shell in this sea, and one would not have expected it to have been as low as eighth in frequency of occurrence (see Table 1). All seven examples are juveniles, however, and as it is a relatively heavy shell with a narrow mouth this may suggest that keeping a foothold is difficult.

The second species on the list is *Rissoa variabilis* (Mühlfeld), and the high position of this on the list is due largely to 16 examples being taken alive at 40 ft in Transect 1. The question arises as to whether this was a chance grouping or whether the species normally lives in colonies. The suggestion is underlined by

Table 2. Mollusca and algae from Transect 1 (Quadrat size 400cm^2).

DEPTH feet	MOLLUSCA	ALGAE
5	2 *Columbella rustica* (L.)	8% *Mesophyllum lichenoides* (Ellis et Soland.) Lemoine 4% Other small red algae 2% *Dictyota dichotoma* (Huds.) Lamouroux 80% *Cystoseira stricta* (Mont.) Sauvageau 6% *Halimeda tuna* (Ellis et Soland.) Lamouroux
7	NO SAMPLES TAKEN AT THIS DEPTH	
10	1 *Gibbula turbinoides* (Deshayes) 1 *Columbella rustica* (L.) 1 *Fasciolaria lignaria* (L.) 1 *Vexillum ebenus* (Lamarck)	1% *Amphiroa beauvoisii* Lamouroux 12% *Lithophyllum incrustans* Philippi 79% *Dictyopteris membranacea* (Stackh.) Batters 4% *Cladophora pellucida* (Huds.) Kutzing
20	1 *Columbella rustica* (L.) 1 *Chauvetia brunnea* (Donovan) 1 *Vexillum ebenus* (Lamarck)	1% *Amphiroa beauvoisii* Lamouroux 3% Other small red algae 49% *Dictyopteris membranacea* (Stackh.) Batters 45% *Cystoseira fimbriata* (Desfont.) Bory
40	4 *Calliostoma conulus* (L.) 2 *Cantharidus exasperatus* (Pennant) 16 *Rissoa variabilis* (Muhlfeld) 1 *Rissoina bruguieri* (Payraudeau) 2 *Bittium reticulatum* (da Costa) 1 *Murex ?cristatus* Brocchi var. *inermis* Philippi 5 *Columbella rustica* (L.) 2 *Chauvetia brunnea* (Donovan) 4 *Nassarius incrassatus* (Strom) 1 *Fasciolaria lignaria* (L.) 6 *Vexillum ebenus* (Lamarck) 2 *Conus mediterraneus* Bruguiere	4% *Amphiroa beauvoisii* Lamouroux 1% *Jania longifurca* (Zanard.) Zanardini 1% *Pseudolithophyllum expansum* (Phil.) Lemoine 14% Other small red algae 4% *Dictyota dichotoma* (Huds.) Lamouroux 25% *Padina pavonia* (L.) Gaillon 40% *Cystoseira fimbriata* (Desfont.) Bory 11% *Cladophora* spp.
60	1 *Calliostoma conulus* (L.) [juvenile] 1 *Alvania cimex* (L.) [dead] 2 *Rissoa variabilis* (Muhlfeld) 2 *Bittium reticulatum* (da Costa) [juvenile] 1 *Chauvetia brunnea* (Donovan) 1 *Vexillum ebenus* (Lamarck) 1 *Conus mediterraneus* Bruguiere	2% *Peyssonnelia rubra* (Grev.) J. Agardh 1% *Peyssonnelia squamaria* (Gmel.) Decaisne 15% *Pseudolithophyllum expansum* (Phil.) Lemoine 2% *Dictyopteris membranacea* (Stackh.) Batters 26% *Cystoseira fimbriata* (Desfont.) Bory 15% *Cystoseira stricta* (Mont.) Sauvageau p *Sargassum vulgare* C. Agardh 4% *Palmophyllum crassum* (Nacc.) Rabenhorst 26% *Cladophora* spp. 5% *Halimeda tuna* (Ellis et Soland.) Lamouroux 4% *Udotea desfontainii* (Lamour.) Decaisne
80	1 *Emarginula elongata* O. G. Costa 1 *Bittium reticulatum* (da Costa)	21% *Peyssonnelia squamaria* (Gmel.) Decaisne 22% *Pseudolithophyllum expansum* (Phil.) Lemoine 1% *Dictyota dichotoma* (Huds.) Lamouroux 1% *Palmophyllum crassum* (Nacc.) Rabenhorst 5% *Cladophora* spp. 42% *Halimeda tuna* (Ellis et Soland.) Lamouroux 8% *Udotea desfontainii* (Lamour.) Decaisne
100	1 *Nassarius incrassatus* (Strom)	4% *Peyssonnelia squamaria* (Gmel.) Decaisne 2% *Pseudolithophyllum expansum* (Phil.) Lemoine 23% *Dictyota dichotoma* (Huds.) Lamouroux 2% *Palmophyllum crassum* (Nacc.) Rabenhorst 63% *Halimeda tuna* (Ellis et Soland.) Lamouroux 6% *Udotea desfontainii* (Lamour.) Decaisne
140	1 *Homalopoma sanguineum* (L.) 1 *Bittium reticulatum* (da Costa)	15% *Peyssonnelia squamaria* (Gmel.) Decaisne 1% *Pseudolithophyllum expansum* (Phil.) Lemoine 1% Other red algae 27% *Dictyota dichotoma* (Huds.) Lamouroux 5% *Palmophyllum crassum* (Nacc.) Rabenhorst 18% *Halimeda tuna* (Ellis et Soland.) Lamouroux 32% *Udotea desfontainii* (Lamour.) Decaisne

p = present

Table 3. Mollusca and algae from Transect 2 (Quadrat size 1600cm^2).

DEPTH feet	MOLLUSCA	ALGAE
5	1 *Diodora apertura* (Montagu) 2 *Gibbula turbinoides* (Deshayes) 3 *Columbella rustica* (L.)	5% *Mesophyllum lichenoides* (Ellis et Soland.) Lemoine 2% Other small red algae 30% *Cystoseira stricta* (Mont.) Sauvageau 60% *Sargassum vulgare* C. Agardh 3% *Cladophora* spp.
7	2 *Gibbula turbinoides* (Deshayes) 4 *Columbella rustica* (L.) 1 *Chauvetia brunnea* (Donovan)	4% *Lithophyllum incrustans* Philippi 4% *Mesophyllum lichenoides* (Ellis et Soland.) Lemoine 70% *Dictyopteris membranacea* (Stackh.) Batters 2% *Cystoseira fimbriata* (Desfont.) Bory 20% *Sargassum vulgare* C. Agardh
10	3 *Gibbula turbinoides* (Deshayes) 6 *Columbella rustica* (L.) 1 *Chauvetia brunnea* (Donovan) 1 *Vexillum ebenus* (Lamarck) 3 *Conus mediterraneus* Bruguiere	p *Peyssonnelia rubra* (Grev.) J. Agardh 5% *Jania longifurca* (Zanard.) Zanardini 2% *Lithophyllum incrustans* Philippi 2% *Pseudolithophyllum expansum* (Phil.) Lemoine 2% Other small red algae 4% *Dictyopteris membranacea* (Stackh.) Batters 32% *Cystoseira fimbriata* (Desfont.) Bory 6% *Cystoseira stricta* (Mont.) Sauvageau 45% *Sargassum vulgare* C. Agardh
20	5 *Calliostoma conulus* (L.) 1 *Gibbula turbinoides* (Deshayes) 1 *Clanculus jussieui* (Payraudeau) 1 *Bittium reticulatum* (da Costa) 3 *Triphora perversa* (L.) 1 *Murex ?cristatus* Brocchi var. *inermis* Philippi 1 *Columbella rustica* (L.) [+ 2 very young specimens] 2 *Vexillum ebenus* (Lamarck)	1% *Peyssonnelia rubra* (Grev.) J. Agardh 1% *Amphiroa beauvoisii* Lamouroux 2% *Jania longifurca* (Zanard.) Zanardini 2% *Lithophyllum incrustans* Philippi 1% *Pseudolithophyllum expansum* (Phil.) Lemoine 16% *Dictyopteris membranacea* (Stackh.) Batters 24% *Cystoseira fimbriata* (Desfont.) Bory 48% *Sargassum vulgare* C. Agardh p *Halimeda tuna* (Ellis et Soland.) Lamouroux
40	NO MOLLUSCA PRESENT	2% *Peyssonnelia rubra* (Grev.) J. Agardh 7% *Peyssonnelia squamaria* (Gmel.) Decaisne p *Amphiroa beauvoisii* Lamouroux 2% *Jania longifurca* (Zanard.) Zanardini 1% *Lithophyllum incrustans* Philippi 4% *Pseudolithophyllum expansum* (Phil.) Lemoine 2% Other small red algae 23% *Dictyopteris membranacea* (Stackh.) Batters p *Dictyota dichotoma* (Huds.) Lamouroux 41% *Cystoseira fimbriata* (Desfont.) Bory 5% *Sargassum vulgare* C. Agardh 4% *Halimeda tuna* (Ellis et Soland.) Lamouroux 11% *Udotea desfontainii* (Lamour.) Decaisne
60	2 *Patella lusitanica* Gmelin [dead] 1 *Gibbula turbinoides* (Deshayes) 1 *Cantharidus exasperatus* (Pennant) 3 *Alvania cimex* (L.) 1 *Alvania montagui* (Payraudeau) 1 *Rissoa variabilis* (Muhlfeldt) 2 *Bittium reticulatum* (da Costa) 1 *Cerithiopsis metaxae* (Chiaje) 1 *Murex ?cristatus* Brocchi var. *inermis* Philippi 2 *Mitrella savignyi* (Payraudeau) 2 *Mitrella scripta* (L.) 5 *Columbella rustica* (L.) 1 *Nassarius incrassatus* (Strom) 3 *Vexillum ebenus* (Lamarck)	4% *Peyssonnelia rubra* (Grev.) J. Agardh 1% *Peyssonnelia squamaria* (Gmel.) Decaisne p *Amphiroa beauvoisii* Lamouroux 1% *Jania longifurca* (Zanard.) Zanardini 1% *Lithophyllum incrustans* Philippi 9% *Pseudolithophyllum expansum* (Phil.) Lemoine 13% *Dictyopteris membranacea* (Stackh.) Batters 1% *Dictyota dichotoma* (Huds.) Lamouroux p *Padina pavonia* (L.) Gaillon 2% *Cystoseira fimbriata* (Desfont.) Bory 4% *Sargassum vulgare* C. Agardh p *Palmophyllum crassum* (Nacc.) Rabenhorst 38% *Halimeda tuna* (Ellis et Soland.) Lamouroux 25% *Udotea desfontainii* (Lamour.) Decaisne
80	NO SAMPLES TAKEN AT THIS DEPTH	
100	2 *Diodora apertura* (Montagu) 2 *Alvania montagui* (Payraudeau) 1 *Mitrella scripta* (L.) 2 *Chauvetia brunnea* (Donovan) 1 *Conus mediterraneus* Bruguiere	2% *Peyssonnelia rubra* (Grev.) J. Agardh 2% *Peyssonnelia squamaria* (Gmel.) Decaisne p *Jania longifurca* (Zanard.) Zanardini 1% *Lithophyllum incrustans* Philippi 1% *Pseudolithophyllum expansum* (Phil.) Lemoine 5% *Polysiphonia subulifera* (C. Ag.) Harvey 9% *Dictyota dichotoma* (Huds.) Lamouroux 1% *Padina pavonia* (L.) Gaillon 1% *Cystoseira fimbriata* (Desfont.) Bory 2% *Sargassum vulgare* C. Agardh 3% *Palmophyllum crassum* (Nacc.) Rabenhorst 48% *Halimeda tuna* (Ellis et Soland.) Lamouroux 25% *Udotea desfontainii* (Lamour.) Decaisne
140	1 *Calliostoma granulatum* (Born) 1 *Gibbula turbinoides* (Deshayes) 1 *Homalopoma sanguineum* (L.) 1 *Rissoa variabilis* (Muhlfeld) 5 *Bittium lima* (Bruguiere) 1 *Murex ?cristatus* Brocchi var. *inermis* Philippi	1% *Peyssonnelia rubra* (Grev.) J. Agardh 2% *Peyssonnelia squamaria* (Gmel.) Decaisne p *Lithophyllum incrustans* Philippi 3% *Pseudolithophyllum expansum* (Phil.) Lemoine 9% *Rhodymenia palmetta* (Esp.) Greville 1% Other red algae 25% *Dictyota dichotoma* (Huds.) Lamouroux 1% *Sargassum vulgare* C. Agardh 1% *Palmophyllum crassum* (Nacc.) Rabenhorst 23% *Halimeda tuna* (Ellis et Soland.) Lamouroux 35% *Udotea desfontainii* (Lamour.) Decaisne

p = present

the fact that a similar occurrence has been found in the collections made by the same exploring group in Sicily, the results of which we hope to deal with subsequently.

Vexillum ebenus (Lamarck) follows in the table: there are 15 specimens in 7 samples, showing it to be fairly evenly distributed over the area examined. This again is a very common Mediterranean species and appears to thrive anywhere. It is extraordinary that DESPOTT (1919) should say of this species at Marsascirocco (only a few miles away): 'scarce; appears to prefer weedy bottoms at various depths . . .'. Mr A. LARKUM has suggested a correlation between this mollusc and the alga *Amphiroa beauvoisii* Lamouroux, both occurring between 10 ft and 60 ft. It is to be noted that in Transect 1 there were six specimens at 40 ft but only one at the other three loci in the transect. As the alga referred to is calcareous it may be that the association is simply because it provides a fairly good foothold for a heavyish shell.

Gibbula turbinoides (Deshayes) occurs in most samples on Transect 2 from 5 ft to 140 ft, and Mr LARKUM has suggested an association between this shell and the alga *Sargassum vulgare* C. Agardh.

Another interesting shell is *Homalopoma sanguineum* (L.), there being one live example found in each of the transects at 140 ft, the lowest depth to which the divers could reach. The divers also found two examples on Xlendi Reef, Gozo Island, at 22 ft and 140 ft, but both specimens were dead. DESPOTT (1919) says: 'A few dead specimens found with the sand and shingle at Birzebbugia'. It looks as if this is a deep-water species, the exact habitat of which requires further investigation.

MOLLUSCA FROM THE AMPHORAE

One of the important tasks of the expedition was to emareate Roman amphorae from the wrecks. In these receptacles a number of shells were found in various stages of deterioration and encrustation with calcareous matter.

LIST OF SPECIES FOUND IN THE AMPHORAE

PELECYPODA

Arca (Barbatia) barbata L.
Glycymeris (Glycymeris) glycymeris (L.)
Pecten (Pecten) jacobaeus (L.)
Chlamys (Manupecten) pesfelis (L.)
Lima (Lima) lima (L.)
Codakia (Jagonia) reticulata (Poli)
Venus (Venus) verrucosa L.
Tellina distorta Poli

GASTROPODA

Patella caerulea L.
Calliostoma (*Calliostoma*) *conulus* (L.)
Clanculus (*Clanculus*) *corallinus* (Gmelin)
Astraea (*Bolma*) *rugosa* (L.)
Turritella triplicata (Brocchi)
Cerithium (*Vulgocerithium*) *vulgatum* Bruguière
Crepidula unguiformis Lamarck
Natica millepunctata Lamarck
Cypraea (*Erosaria*) *spurca* L.
C. (*Schilderia*) *achatidea* Sowerby
Phalium (*Semicassis*) *sulcosum* Born
Columbella rustica (L.)
Euthria cornea (L.)
Conus mediterraneus Bruguière
*Cavolina** *uncinata* (Rang)

The single specimen of the cowry *Cypraea* (*Schilderia*) *achatidea* Sowerby is one of the most heavily calcified of the shells from the amphorae. The Pennsylvania University Turkish Underwater Expedition 1960 also took one example of this species from a Bronze Age wreck dated at about 1200 B.C. in 90 ft of water off a headland a few miles west of Antalya, southern Turkey. This latter example is more heavily encrusted. These two examples have been compared with Recent specimens in the British Museum (Natural History) which are about the same size, allowing for the thickness of the encrustations, and all four have been weighed (Table 4).

Table 4

SPECIMEN	LENGTH	BREADTH	HEIGHT	WEIGHT
Malta	42·5 mm	26·0 mm	23·0 mm	10·00 gm
Turkey	43·6 mm	28·1 mm	23·3 mm	27·35 gm
B.M.(N.H.)	39·4 mm	24·6 mm	20·4 mm	7·22 gm
B.M.(N.H.)	39·7 mm	24·6 mm	21·0 mm	7·76 gm

These are interesting figures and suggest that the longer this species remains under water the more encrusted it becomes, but this may not always be the case and a study of individual species is necessary.

The most striking example of lack of calcification is the single valve of *Tellina distorta* Poli which has the full colours on the shell as bright and fresh as the specimen in the NORMAN Collection at the British Museum (Natural History) from which the determination was made. This fact does not mean that it has not been in the amphorae for as long as any of the others; it simply means that this is one of the species which cannot be used to gauge the length of time a wreck has been under water, using the advancement of calcification as a guide.

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* The correct spelling of this generic name—*Cavolina* or *Cavolinia*—is at present *sub judice* by the ICZN. The original spelling was adopted by WINCKWORTH for the British List, and is retained here pending the decision of the Commission—Editor.

Writing of a band of elevated coral behind Suakin and Port Sudan on the Red Sea coast, CROSSLAND (1913: 131) puts the question of the retention of colours this way, in a footnote: 'Actually many of these shells retain some of their colour! e.g. the red of the common *Spondylus*, the bands of *Strombus fasciatus* and the mottlings of *Cyprina tigrina* are quite distinct on some specimens from 100 feet above, and on others dug out 15 feet below sea level.' He seems to refer these to 'thousands of years before the builders of the pyramids' on the following page. On p. 133 he writes: 'when the slipway was excavated at Port Sudan' he had the opportunity of examining the internal structure of cliffs of coral and 'At a depth of five metres I picked out shells retaining almost perfectly the colours and appearance of their living relatives of the same species'. *Tellina distorta* is red, the *Spondylus* CROSSLAND refers to is red, the bands on *Strombus fasciatus* are purplish: could there be any significance in these colours?

Having examined two species of shell, one with an extreme amount of encrustation and the other totally unaffected by long immersion in salt water, let us examine the others. Where the same species of shell occurs in the collection from the Bronze Age wreck off the Turkish coast I [H.E.J.B.] should like to compare the states of the specimens from the two collections, although the dates of the two sites are more than 1,000 years apart. A complete report on all the species from the Turkish site has been made but, to the best of my knowledge, not published. The shells may conveniently be separated into four groups.

A. Heavily encrusted shells

Glycymeris (*Glycymeris*) *glycymeris* (L.) is represented by eight single valves. One example is much less encrusted than the others and retains much of its original purplish colour.

Lima (*Lima*) *lima* (L.) ssp. *squamosa* Lamarck. One valve very heavily encrusted and somewhat more so than the Bronze Age example from the Gulf of Antalya.

Venus (*Venus*) *verrucosa* L. One valve only.

Astraea (*Bolma*) *rugosa* (L.). There are sixteen examples of this species, all about equally heavily encrusted and with no colour. This is the commonest species of shell in the collection. By contrast, in the Bronze Age wreck there was only one damaged example of this species, in about the same state as the Malta specimens.

Cypraea (*Erosaria*) *spurca* L. Whereas the examples from the Roman amphorae are considerably encrusted, those from the Bronze Age wreck are still well polished and have some of the spots round the edge of the shell quite distinct; these latter specimens, it must be remembered, have been under the water about 1,000 years longer.

C. (*Schilderia*) *achatidea* Sowerby is dealt with above.

B. Moderately encrusted shells

Chlamys (*Manupecten*) *pesfelis* (L.). Two valves from the amphorae are in precisely the same state as the two from the Bronze Age wreck.

Calliostoma (*Calliostoma*) *conulus* (L.). Two examples, one quite heavily encrusted and the other retaining its full polish and some show of colour.

Cerithium (*Vulgocerithium*) *vulgatum* Bruguière. Two examples; one from the Bronze Age wreck is very fresh looking.

Phalium (*Semicassis*) *sulcosum* Born. Two examples.

Euthria cornea (L.). Three examples.

C. Lightly encrusted shells

Arca (*Barbatia*) *barbata* L. Two valves, in the same state as the one valve from the Bronze Age wreck.

Pecten (*Pecten*) *jacobaeus* (L.). Two valves.

Lima (*Lima*) *lima* (L.). Four valves somewhat less encrusted than the three from the Bronze Age wreck. One of the latter has a quantity of a copper salt, green in colour, still adhering to it.

Codakia (*Jagonia*) *reticulata* (Poli). Three complete examples and four odd valves.

Clanculus (*Clanculus*) *corallinus* (Gmelin). One example.

Turritella triplicata (Brocchi). One example.

Natica millepunctata Lamarck. One example.

Conus mediterraneus Bruguière. Two examples, one with a certain amount of colour remaining.

D. Shells not encrusted

Tellina distorta Poli. One example, for details see above.

Patella caerulea L. One example with some colour remaining in the form of some brownish streaks on the inside.

Crepidula unguiformis Lamarck. One example.

Columbella rustica (L.). One example, with a great deal of colour.

Cavolina uncinata (Rang). One example.

Before it will be possible to use Mollusca as a useful 'yard-stick' for helping to date underwater sites and prehistoric wrecks much more work will have to done on the reactions of the shells of the different species to prolonged immersion. It is hoped that the publication of the above results will stimulate others engaged in underwater exploration to preserve carefully with full data all Mollusca seen.

General Collecting

Besides collecting from the transects and from the amphorae, the expedition members took shells on the shore at various places and on dives other than at the transects. Small collections were made along the shore at Marsaxlokk [Marsascirocco on many maps], and on Cominotto, Comino and Gozo Islands.

Most of the species collected have already been recorded for the islands but there remain several species which appear to be unrecorded, at least under the name here used. Some others, although previously noted, also deserve some comment.

Pinctada radiata (Leach). One juvenile example of this species was taken, but the exact locality is not given. The species is an intruder into the Mediterranean from the Red Sea.

Gibbula turbinoides (Deshayes). For details of this previously unrecorded species see Tables 1–3.

Cantharidus exasperatus (Pennant). Besides the examples recorded in Tables 1–3, the species occurred on Xlendi Reef, Gozo I., at 30 ft and on Cominotto I. at depths of 30 ft and 60 ft, one example at each level. It is a fairly common Mediterranean species.

Alvania lineata (Risso). On Xlendi Reef, Gozo I., the expedition took this species at 120 ft, but as this example was a dead shell there may be some doubt as to whether the species does live at that depth in the islands. On Comino I., two examples at 45 ft. A shell from 38 ft at Cominotto I. is possibly this species.

Cerithium pulchellum Philippi. Cominotto I., one example at 30 ft, either a live specimen or in very fresh condition when taken. Marsaxlokk, eighteen dead shells at the water's edge.

Cerithiopsis metaxae (Chiaje). Only one example taken on Transect 2 at 60 ft. Not recorded by previous writers.

Charonia variegata (Lamarck). The only previous record, under the generic name *Tritonium*, is that of CARUANA (1867) who notes: 'very rare'. Three specimens were taken live by the expedition, one 27 cm and another 29·2 cm in height. The surfaces of two of these now in the possession of the authors are encrusted and pitted with holes of marine worms; one operculum seems to have suffered in a similar manner.

Columbella decollata (Bruguière). Comino I., nine examples at 17 ft. Cominotto I., one juvenile at 38 ft. Marsaxlokk, one example at sea level. Not previously recorded for the islands.

ACKNOWLEDGMENTS

We wish to express our thanks to the Imperial College Exploration Board and to Martini Rossi Ltd who gave financial support, thereby making this work possible. The senior author is grateful to Professor H. R. HEWER of the Imperial College of Science and Technology, University of London, for giving him the opportunity of working on the Mollusca collected by the expedition and for permission to retain the material in his collection. It is hoped that eventually this material will be placed in some public collection and so be available to future students. He is also grateful to the authorities of the British Museum (Natural History) for allowing him to make determinations from the collection

in the Mollusca Section in the care of Mr NORMAN TEBBLE. Our thanks are due to Mr A. LARKUM for his work on the algae herein enumerated and also to him and Mr P. REDFEARN for helping C.W. to collect the material on the transects.

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Report on Junior Membership for 1964
(First Year)

(The following Report has been approved by Council)

Junior Membership in the Society was established as from 1 January 1964.

Articles, long and short, and notices (one quite minute) have appeared in nine journals, etc. Although these were primarily intended to give information about Junior Membership they have also served to publicize the work and aims of the Society and brought enquiries from several parts of the world as well as many places in the British Islands.

The idea of publishing *Papers for Students* was to help these new Junior Members; this has been achieved and at the same time they have been of service to a number of our adult Members who have expressed their appreciation of them. So far four papers only have been published, but four more are in various stages of completion and should be out shortly. Unfortunately only about a dozen sets have been sold outside the Society's membership.

Junior Membership now stands at twelve. As many again have written in enquiring about membership. This should be considered healthy growth, too many would have been difficult to deal with.

The meetings for Junior Members were not well attended; only two were held. It would have been better had we delayed arranged meetings till our membership was larger.

A small number of our Members have addressed gatherings of young people. The Secretary would be glad to hear of other opportunities of addressing gatherings on the work of the Society.

H. E. J. BIGGS

J. Conch. **26**: 66–68. (1966)

MAURITIA MAURITIANA (L.) AT ADEN

F. A. Schilder
University of Halle, Halle/Saale, German Democratic Republic

(*Read before the Society*, 16 *October* 1965)

The rather common cowry *Mauritia mauritiana* (L.) is widely distributed in the Indo-Pacific from eastern Polynesia to the east coast of Africa, but it is absent from the Red Sea and the Persian Gulf (Schilder, 1965). In the boundary zone it becomes rare: Mr M. Liversidge told me (*in litt.*) that he has collected living *M. mauritiana* 19 miles east of Mogadishu, in Somaliland; Jousseaume (1888: 191) reported two shells only from Obock; I saw one shell from Massawa in the museum at Florence (which might have been brought to the Eritrean market place from elsewhere); and according to Melvill & Standen (1904: 120) *M. mauritiana* was said by natives to live at Muscat on rocks at extremely low tide.

From Aden, *M. mauritiana* has been listed by Shopland (1896: 226; 1902: 175), but not by Maxwell Smith (1912), so that it must be uncommon there. Mr W. L. Lander did not find any specimen during several years' collecting along the coasts of Aden and Little Aden: *M. mauritiana* was totally absent even at Tarshyne Point on the western end of Aden Peninsula where the cowry fauna is very rich, including several species which are absent in other localities (Schilder, 1962). But on 'the 28 May 1962 when the seas had died down', Mr Lander discovered a population of fifteen *M. mauritiana* at Ras Marshag, the opposite eastern point of Aden Peninsula, 'in an area only 150 yards long which is normally quite inaccessible: they were on rocks that seemed devoid of all food apart from a very sparse covering of algae; this almost barren place is subjected most of the time to heavy surf, the living specimens were on or under large boulders in about four to eight feet of water' (Mr Lander *in litt.*).

This population of *M. mauritiana* living under unfavourable conditions shows some peculiarities which deserve to be discussed. The length (in mm), the relative breadth (as % of length), and the closeness of the teeth (according to the formula of Schilder, 1958) of the thirteen adult specimens (A–N) presented to the author by Mr Lander are as follows:

A 74/72 *mm*
B 81/71 *lk*
C 84/76 *mm*
D 86/68 *kk*
E 88/72 *kk*
F 89/71 *ml*
G 89/72 *ll*
H 94/69 *li*
J 95/72 *nn*
K 95/70 *lk*
L 98/70 *lm*
M 99/67 *lm*
N 100/ 71 *mk*

These figures show that the shells from Aden are large: the usual size—i.e. the length of two-thirds of specimens approaching the mean—is 60–86 mm in about 500 adult *M. mauritiana* from the whole Indo-Pacific, 77–88 mm in 23 shells from Mombasa Island, and 84–98 mm in the 13 shells from Aden; the range of breadth and dentition, however, is as usual.

The base is rather concave in front (especially in D, F, L and M); the posterior extremity of the inner lip is often acuminately produced (especially in E) or produced and constricted in a mammiform way (in L and M, extremely so in H); the aperture is wide and the fossula is very shallow (especially in H, L and N, but not in A).

The most striking features, however, are that in most specimens (A and N excepted) the anterior extremity of the inner lip, or of both lips, is damaged or totally broken off and the injuries healed by a thin covering layer of translucent accessory enamel; in K, the posterior extremity is also broken off on both lips, and the subrostrate appearance of M may also be caused by injuries healed a longer time ago; the dorsum also shows injuries ranging from small whitish holes (D, H, L) to large areas in which the uppermost layer of enamel is torn off (E, G, J, L, M, N), but always replaced by thin layers of accessory translucent enamel at least on the borders of the wound. Evidently the rolling by the surf on the rocks has caused these injuries to the vulnerable parts of the solid shells, but the animals survived the accidents and tried to repair the damage.

These unusually frequent abnormalities in structure are accompanied by anomalies in colour: the dorsum shows the usual large (A, B) or small (K) pale lacunae in the chestnut network, which becomes dilacerate (G, J, N) to confused (C) in some specimens; in other shells, however, these typical markings are partly covered by large chestnut blotches of irregular shape (D, E, H) which can become confluent so that they obscure the typical markings over the whole dorsal area (F, L, M). This pathological suffusion may include small to large bluish-grey patches (especially in D and M), and the same greyish colour also suffuses the blackish-brown margins to various degrees, while in the most pathological shell (L) the narrow margins and the undulate base are dirty brownish-grey with irregular chestnut patches. Evidently these abnormalities in colour are induced by injuries to the animal's mantle, suffered during the life in the heavy surf.

Though the special environment of this population of *Mauritia mauritiana* has evidently caused all these peculiar characters of shape and colour, the population seems strong enough to hold out in these unfavourable surroundings on the border of the area of distribution of the species.

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The Sea Shells of Dar es Salaam by J. F. Spry. Part II—Pelecypoda (Bivalves). pp. 1–41, 4 col. pls. + 4 plain pls. 8vo. Reprinted from *Tanganyika Notes and Records* No. 63, 1964. Obtainable from the Tanganyika Society, P.O. Box 511, Dar es Salaam, Tanzania. Price 9s 50cts or 10s 6d sterling.

When I reviewed the companion pamphlet on gastropods [*J. Conch.* **25**: 88], I ventured to hope that Mr Spry would favour us with a similar account of the bivalves. This he has now done and once again illustrated it with his own drawings and paintings. Once again it does not claim to be a scientific document—it is a list of findings in Dar es Salaam with such names as the author has been able to work out for them. Until the Indian Ocean bivalves are revised for the *Indo-Pacific Mollusca* series only a magician could name some of the species [only the Pinnidae and Tridacnidae have so far been revised]. One can spend the whole day trying to arrive at the correct name for one shell. Even the major groupings within the bivalves are far from stable and different works use different systems; new systems seem to be produced every year. To an amateur this must all be very discouraging. Few would have the courage to produce a work on a local tropical bivalve fauna and Mr Spry is to be congratulated. It is obvious from the omissions of specific names and alternative names that he has had great difficulties with naming. I note also that his names frequently differ from those I obtained (for what is obviously the same shell) from workers in Europe. One rather noticeable fault is the lack of uniform treatment with regard to generic names. *Crassostrea*, *Lopha*, etc., are all lumped under '*Ostrea*', yet where one would expect '*Pecten*' or at the most '*Chlamys*' one finds '*Gloripallium*'. This is no doubt due to differences in treatment in the references used.

There are some quite noticeable errors. Linné's name lacks the accent throughout; authors' names are all placed in parentheses indiscriminately whether or not the species has been moved from the genus in which it was described; I think it is unlikely that Gmelin and Linné ever got together and described a species as is suggested on p. 7; '*Quodrans*' and '*quodrizonata*' should surely be '*Quadrans*' and '*quadrizonata*'; the dimensions of *Cardium pseudolima* are given as 6·5 × 7·3 cm, but this must be a youngster since I have one from Zanzibar—the only bivalve from East Africa I possess—which measures 11·5 × 11·5 × 8 cm.

Literature on bivalves for collectors is almost non-existent, and I am sure collectors will want to buy this booklet. Whoever is faced with the revision of bivalve families will badly need carefully labelled collections for study, and it is to be hoped that Mr Spry's collection will be made available to them. There is a wealth of material in private hands in East Africa, but only very rarely are duplicates passed on to the larger museums.

B. Verdcourt

J. Conch. **26**: 69–70. (1966)

MARGARITIFERA MARGARITIFERA (L.) IN HARD WATER IN SCOTLAND

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(*Read before the Society*, 13 *March* 1965)

The pearl mussel *Margaritifera margaritifera* (L.) normally lives in soft water (Boycott, 1936: 133) and is generally distributed in Scotland. In Ireland the species also lives in hard water (the rivers Nore and Suir), where it is represented by the form *durrovensis* Phillips, but hitherto its occurrence in hard water in Scotland does not seem to have been noticed.

Orkney water is very hard and the Loch of Stenness in Mainland, the largest of the Orkney islands, is a large (2½ sq. miles), shallow, hard-water loch which is also brackish. Nicol (1938) gives details of it, and it seems a most unlikely place in which to find *Margaritifera*. Yet the late Mr James Bruce, Assistant Curator of the Stromness Museum, took in it, before 1957, three fine living examples of the species. One he picked up at the Point of Unstan, east of the Bridge of Waith; the other two at Deepdale, farther west. There seems no reason to doubt the record and, when questioned, Mr Bruce told me that he had never collected shells anywhere other than in Orkney and that these three *Margaritifera* (now in Stromness Museum) were the only specimens of their kind he had ever seen. By the kindness of the late Provost Marwick and Mr W. Groundwater, Rector of Stromness Academy, Mr A. E. Ellis has seen these specimens and considers them to be typical *M. margaritifera*, not the hard-water form *durrovensis* as might have been expected.

A modest footnote on p. 156 of Childe's *Skara Brae* (1931) runs thus: 'Similarly pearl-oysters [sic] are found near the Bridge of Waith but the pearls are so small that they cannot have found many buyers.' Unfortunately I have not been able to obtain any further information about these 'pearl-oysters' and Dr Isobel Smith, who worked with Childe for a considerable time, knows nothing of them, but the note hints at previous finds of *Margaritifera* in the vicinity.

In August 1957, Dr H. B. N. Hynes found abundant small but adult specimens of *Margaritifera* in a hard-water stream flowing from a loch which drains into Clashnessie Bay, north of the Point of Stoer in west Sutherland, but unfortunately Dr Hynes kept no specimens. Perhaps this is the locality for 'var.

sinuata' quoted by ROEBUCK (1891): 'near Stair Point, Assynt (W. BAILLIE)'. This record is repeated, with the addition of the date 1883, by JACKSON (1925: 208). It is not clear which variety was actually obtained, as var. *sinuata* Lamarck has been shown to refer to *M. auricularia* (Spengler), a species no longer living in Britain. If BAILLIE's specimens are in the Conchological Society's Voucher Collection it would be of much interest to know whether they are of the typical form or *durrovensis*.

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J. Conch. **26**: 71–72. (1966)

THE TYPE-SPECIES OF *MARCONIA* BOURGUIGNAT (STREPTAXIDAE): A CORRECTION

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(*Read before the Society*, 16 *October* 1965)

Dr W. Adam of Brussels has pointed out to me a serious error in my paper on *Gonaxis* (Verdcourt, 1961). In this paper I not only followed Thiele and Pilsbry in accepting *Marconia gibbosa* Bourguignat as the type of *Marconia*, but also stated that Bequaert & Clench (1936) did not discuss the problem of *Marconia* when actually they treated it in some detail. This was due to the fact that the actual paper by these authors was not available to me in Kenya, and I relied on incomplete notes I had made some years before. Bequaert & Clench mention that Kobelt's selection, made in 1906, of *Ennea lata* Smith as the type-species of *Marconia* is valid, and that Pilsbry was incorrect. Pilsbry probably thought it better to select a species actually described by Bourguignat than one merely included by him in his new genus.

The divisions of *Gonaxis* I used in my paper require to be altered slightly in view of this careless error. The type-species of *Gonaxis* is *G. gibbonsi* Taylor, a species which has not been dissected but which I assumed would almost certainly prove to have the same anatomy as *G. denticulatus* (Dohrn). Dr Adam (*in litt.*) questioned the validity of this guess, but I am even more convinced since I have now seen series of *G. gibbonsi* from Zanzibar and series of *G. denticulatus* from the mainland of East Africa which vary in size so much that they throw doubt on the specific distinctness of the two. *G. denticulatus* has a radula in which the size of the teeth in each half row reaches a maximum twice. *Ennea lata* Smith and *Ennea latula* von Martens (both usually referred to *Marconia*) and *Gonaxis usambarensis* Verdcourt also have this type of radula. Other species often referred to *Marconia*, e.g. *Ennea elgonensis* Preston and *Marconia gibbosa* Bourguignat, have a radula with only one maximum per half row. The result is that where, in my original paper, I used '*Gonaxis* subgenus *Gonaxis*' and '*Gonaxis* subgenus *Marconia*' for two of the five divisions of *Gonaxis* I recognized, these should have been '*Gonaxis* subgenus *Gonaxis* (= *Marconia* Bourguignat)' and '*Gonaxis* subgenus novum', but I am refraining from inventing a new name where one is not available since the number of species examined anatomically is only adequate to suggest how the existing available names could be arranged.

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Proceedings of the First European Malacological Congress, London 1962 edited by L. R. COX and J. F. PEAKE. London: Conchological Society of Great Britain and Ireland and the Malacological Society of London, 1965. pp. vii + 266, including frontispiece and 32 pls. Large 8vo. Price £2 or $6.

This impressive volume forms a suitable introduction to a wider scientific public of the activities of the Unitas Malacologica Europaea. The quality and variety of the papers read at its first Congress promise well for the future and are an indication—if such be needed—of the breadth and significance of malacological studies.

It is revealing to be informed by G. THORSON in the first paper that the European Atlantic shelf carries a population of some 1,245 benthic molluscs and to have this number divided up into a series of fifteen groups resident between Murmansk and Gibraltar. Loricates, bivalves and scaphopods form everywhere a fairly stable element, but gastropods are commonest in the north. Direct development is most frequent there, which leads to the valuable and well illustrated contribution by K. W. OCKELMANN on the three developmental types—characterized by planktotrophic larvae, lecithotropic larvae and by direct development—found in the bivalves within this area. The distribution of these animals over the wider area of the arctic seas of Eurasia is dealt with by Z. A. FILATOVA of Moscow. This vast extent is populated by only some 123 species and 45 subspecies.

The final effect of the conversion of the brackish Zuiderzee into the freshwater IJsselmeer is considered by W. S. S. VAN BENTHEM JUTTING. No marine mollusc has survived; invasion from fresh water has been slow. *Dreissena* with its pelagic larvae and *Anodonta* with glochidia have spread fastest; amongst the Gastropoda only *Potamopyrgus* is equally successful. V. FRETTER writes with authority about the interrelationships of monotocardian gastropods and B. HUBENDICK about the patelliform shape and classification—confining himself to the basommatophoran limpets. The synopsis of a lecture by ANNA M. BIDDER on *Nautilus* is illustrated, as frontispiece, by a photograph of a living *N. pompilius* taken at New Caledonia.

Later papers concern pulmonates. There is one on some trends in the evolution of European molluscan faunas by T. SORGENFREI in which he stresses the importance, when studying fossil forms, of considering environmental factors. In a well illustrated paper the distribution and relationships of the land snail *Trichia hispida* are considered by L. FORCART and this is followed by an account of faunistic work on snails in Sweden by H. W. WALDÉN, while C. F. SACCHI considers factors controlling the distribution of these animals in the Iberian peninsula.

There are important papers on aspects of physiology and histology: one by F.-W. SCHLOTE on the musculature and its innervation in *Helix*, a second on features of gastropod musculature and its control by N. POSTMA, and a third on the fine structure of the nervous system and heart in *Archachatina* by M. I. BAXTER and R. H. NISBET. The first and last are illustrated by extensive series of electron photomicrographs. All are important contributions. A paper by A. J. CAIN on recent population studies on *Cepaea* and one on chromosome numbers in pulmonates and opisthobranchs by J. B. BURCH—indicating possible changes in current views on relationships—extend the scope of the contents into the associated fields of genetics and cytology.

C. M. YONGE

J. Conch. **26**: 73–74. (1966)

COMMENTS ON T. E. CROWLEY'S PAPER ON *ASPATHARIA BOURGUIGNATI* (BOURGUIGNAT)

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(*Read before the Society*, 16 *October* 1965)

I wish to make a few comments on a recent record of *Aspatharia bourguignati* (Bourguignat) from the Somali vegetation zone of eastern Kenya (CROWLEY, 1964: 263). The taxon so excellently figured in the paper is common in this area from which it has been known for some fifty years. The following is a list of records known to me, extracted from my manuscript check-list of East African non-marine Mollusca; the material is preserved in the National Museum, Nairobi (formerly the Coryndon Museum).

KENYA. Northern Frontier Province: Lorian Swamp and Meri (J. FLEETWOOD). Turkana District: Lotikipi [Lotagipi] Swamp, near the Sudan border (A. FORBES WATSON). Machakos District: Simba (A. B. PERCIVAL in CM F194); Athi (A. B. PERCIVAL in CM F196) [probably refers to a point on the R. Athi much further to the east than the small town of Athi, which is close to Nairobi; there are no records from so far up the river]. Teita District: R. Voi, Marijau (J. C. McARTHUR in CM 2667–2677). Kwale District: Maji ya Chumvi (B. VERDCOURT). Kilifi District: L. Jilore (B. VERDCOURT, P. WHITEHEAD).

Zoogeographically the area containing the localities cited above is very different from the type-locality given for *Aspatharia bourguignati* by BOURGUIGNAT (1885: 12), namely Tanganyika 'sur les bords méridionaux de l'Oukéréwé, non loin de la Mission française'. This citation of type-locality is given quite unambiguously by BOURGUIGNAT and I see no reason to doubt its accuracy.

The naming of specimens of *Aspatharia* is an extremely difficult matter and it is probable that all the African taxa are best treated as subspecies of one or two species. The one under consideration I have usually referred to *Aspatharia hartmanni haasi* (Pilsbry, 1923) described from material collected by DONALDSON SMITH in the Boran country in the Northern Frontier Province of Kenya. A specimen from Jilore was sent to Dr F. HAAS by T. PAIN and confirmed several years ago. It is, however, difficult to see how it can be separated from *Aspatharia hartmanni guillaini* (Récluz, 1850) which occurs in the R. Juba, Somali Republic (S.) and in the Lamu District of the Coastal Province of

Kenya, where it has been collected at Witu, Mlango ya Simba by P. J. GREENWAY. I would tentatively suggest that all the specimens cited in this paper, together with that figured by CROWLEY, should be known by this name, and that *Aspatharia bourguignati* needs further investigation before it can be claimed to be the same.

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CROWLEY, T. E., 1964. *Aspatheria* [sic] (*Spathopsis*) *bourguignati* (Bourguignat). *J. Conch.* **25**: 263–265, pl. 18.

Russian–English Biological Dictionary compiled and edited by C. W. DUMBLETON. Edinburgh and London: Oliver & Boyd, 1964. pp. xiii + 512. 8vo. Price 63s.

It is perhaps surprising, considering the wealth of biological literature published every year in the Russian language, that there has hitherto been no Russian–English dictionary providing an adequate coverage of biological terms. The present work goes a long way towards satisfying this need. The compiler, who has been a senior translator with the World Health Organization since 1958, has assembled some 25,000 entries, culled from modern Russian books and papers on all aspects of animal and plant biology, exclusive of pathology; a few obsolete terms are also admitted. It must be stressed, however, that this work is not a 'scientific dictionary', such as is available for the French and German languages, but a dictionary of biological terms and vernacular names of animals and plants, and must be used in conjunction with a good general dictionary; few words found in such a dictionary are included, and a knowledge of Russian grammar is assumed.

The Russian tendency to use only vernacular names, especially in ecological works, has been acknowledged by the inclusion of a very large number of them—in particular those of plants, birds, fish and insects—together with their English equivalents and scientific names. The invertebrates are mostly those of medical or economic importance—the Mollusca, for instance, being represented by such genera as *Buccinum*, *Littorina*, *Mytilus*, *Teredo*, etc.—and the selection of species appears to have been somewhat random. The genus *Helix*, for example, is represented only by *H. pomatia* and *H. arbustorum*, and one wonders why the entry 'гребенчатка a mollusc *Cristura plicata*' [p. 101] was included. The molluscan classes and major orders are given, the 'Aplacophora order' of p. 48 being promoted to 'Aplacophora subclass' on pp. 134 and 253.

Few serious errors were noted, but 'киленогие моллюски' [p. 253] are not Pelecypoda, as stated, but Heteropoda, and the consecutive entries on p. 401:

'с [лизень] пашенный grey slug *Agriolimax agrestis* L.
'с., полевой grey field slug *Limax agrestis* L.'

are confusing, as both refer to the same species. The authors of a number of the scientific names are not given, and spelling mistakes are not too rare, e.g. 'Pholidacea' [p. 161], 'Noah's arc' [p. 186], '*Pholas dactylas*' [p. 232], 'Limexylidae' [p. 383], 'Sphaeridae' [p. 487], as well as the obsolete '*Dreissensia*' for '*Dreissena*' [p. 122], '*Avicula*' for '*Pteria*' [p. 136] and '*Vivipara*' for '*Viviparus*' [pp. 137, 231].

Adjective-noun combinations are arranged under the noun: as there are sometimes several columns of entries under such words as 'nerve', 'acid', 'gland', and as each entry after the first is abbreviated to the first letter of the noun, it would have been a considerable time-saver if the first entry of each column had been spelt out in full.

DUMBLETON's *Russian–English Biological Dictionary* will undoubtedly be a standard work of reference for a long time to come, however, and will be most useful for anyone interested in current Russian contributions to his own special subject.

DAVID HEPPELL

CHARLES JOHN GABRIEL
1879–1963

J. Conch. **26**: 75–76. (1966)

OBITUARY

CHARLES JOHN GABRIEL, 1879–1963

With the death of CHARLES JOHN GABRIEL, on 19 June 1963, Malacology lost one of that select band of amateur naturalists whose writings have added so much to our knowledge of local faunas and whose collecting activities have enriched the world's museums of natural history. GABRIEL's energies were devoted to collecting, cataloguing and describing the molluscs of his native Victoria—a task on which he was working right up to the time of his death—and, especially in his early years, he undertook extensive dredging in Western Port and Port Phillip Bay. For twenty-six years he collaborated with J. H. GATLIFF in adding to and revising the 'Catalogue of the marine Shells of Victoria' which had been published by GATLIFF and J. W. PRITCHARD between 1898 and 1906. After GATLIFF's death, in 1934, the job of keeping the catalogue up to date was carried on by GABRIEL. A year before GABRIEL's death, the information previously scattered throughout many publications was united in a single work, the 475-page *Marine Molluscs of Victoria*, written in co-authorship with J. HOPE MACPHERSON, in which all the marine shells of that state are listed, the more common ones described, and their distribution in and beyond Victoria discussed.

GABRIEL's life-long interest in natural history had its beginnings in his earliest years. He was born at Abbotsford, Victoria, on 28 May 1879, the eldest son of JOSEPH and ELIZABETH LOVATT GABRIEL. His father, a pharmacist, was a keen member of the Field Naturalists Club of Victoria and an honorary collector for the National Museum of Victoria. It was at his father's instigation that the young CHARLES, then only nine years old, entered an exhibition of sea shells in the Field Naturalists Club Show of 1888 and thereby won his first natural history award. He was proposed for membership of the Club in 1900 and his first paper appeared in that Club's publication, *Victorian Naturalist*, in July 1908. Altogether he published nearly fifty scientific papers on both marine and non-marine Mollusca, many of them in collaboration with GATLIFF or other authors, and a complete bibliography of these is given by J. HOPE MACPHERSON in *J. malac. Soc. Aust.* **7**: 4–6 (1963).

GABRIEL was one of the oldest Members of the Conchological Society, having been elected in October 1907 and becoming a Life Member the following year. When the practice of giving eminent local workers the status and privileges of honorary association with the curatorial staff was introduced at the National Museum of Victoria in 1933, CHARLES GABRIEL was appointed honorary curator of shells—a title changed a little later to honorary associate in conchology. He presented all the type-specimens in his collection to the museum and, thereafter, handed over all type-material and representatives of new records on the completion of each paper. In all, five new genera and about a hundred and twenty new species were described in his papers. In 1958 he was awarded the Australian Natural History Medallion for his contribution to the spread of interest in natural history—he was always ready to help and encourage the beginner and for many years instructed and exhibited at the monthly meetings of the Field Naturalists Club and at their annual nature show. On his death his entire collection and valuable conchological library were willed to the National Museum and will thus be available to future generations of conchologists.

I am indebted to Mrs J. H. BLACK (née MACPHERSON) for providing a copy of the only photograph of GABRIEL taken in recent years, and for the information on which the above account is based.

DAVID HEPPELL

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

820th (Annual General) Meeting, held at the British Museum (Natural History), 20 February 1965

The President, Dr M. P. KERNEY, in the Chair.

Members Elected

PHILLIP W. CLOVER, Navy 535 Box 10, F.P.O., San Francisco, California 96623, U.S.A.
Mrs ELIZABETH KINLOCH, 22a Queen's Gate Place Mews, London S.W.7.
K. H. P. KURZ, 39 Anne Street, Warilla, N.S.W., Australia.
DENIS O'FLANAGAN, 51 Ailesbury Road, Ballsbridge, Dublin 4, Ireland.
MARIANO LOPEZ SOCAS, Calle Jose Betancourt 7, Arrecife, Lanzarote, Canary Islands.
JEFFREY WOLFF, Department of Zoology, University of North Carolina, Chapel Hill, N.C., U.S.A.

Appointment of Scrutineers

Mr R. J. CLEEVELY and Mr P. E. NEGUS were re-appointed Scrutineers.

Election of Auditors

Mr P. COXHEAD and Miss M. MAITLAND HOWARD were re-elected Auditors.

Annual Reports

The Reports of the Council, the Recorders for non-marine and marine Mollusca, and the Field Meetings Organizer were presented and adopted. The Hon. Treasurer presented the audited accounts for 1964 (see Volume 25, page 372), which were adopted.

Report of the Council

MEMBERSHIP. The Society has suffered most grievously this year through the deaths of some of its senior members, and the losses included some of the most eminent conchologists of our time.

Those whom we have lost include Dr K. H. Barnard, Mr E. W. Fletcher, Dr L. W. Grensted, Dr F. de Havas, Dr L. B. Langmead, Mr A. E. Salisbury, Miss A. M. Saunders and Dr A. O. de Zarate. In addition, five members have resigned. Forty-five new members were elected during the year and two reinstated. This results in a net increase in membership of 34, which includes four honorary and 19 life members: total membership stands at 320. It is a tribute no less to the energy of the Hon. Treasurer than to the probity of the membership, that once again no individual was removed from the lists for non-payment of dues. Subscribers number 106.

Meetings. Seven ordinary meetings, an annual general meeting and a special general meeting have been held during the year in the British Museum (Natural History), by kind permission of the Trustees, the average attendance being 37. In connexion with these meetings, the Society was privileged to hear a lecture on *Theba* by Mr J. F. Peake and one on Marine Research at Malta by the Revd H. E. J. Biggs and Mr C. Wilkinson, both lectures being illustrated by coloured slides. A series of field meetings was organized, and is the subject of a separate report.

Publications. Volume 25, No. 6 of the *Journal of Conchology* was dated 19 June [published 11 July 1964] and No. 7 was dated 18 December [published 23 December 1964]. Of the *Conchologists' Newsletter*, issues were made in May, September and December.

Recorder's Report: non-marine Mollusca

A. Vice-county Records

The following vice-comital records have been verified since the last report (*J. Conch.* **25**: 305):

Channel Islands (0): *Hydrobia ulvae*, *Hydrobia* cf. *neglecta* (dead shells), Herm, Miss Eleanor Fogan, 1964; *Lymnaea stagnalis*, St Peter Port, Guernsey (probably introduced), G. W. Pitchford, August 1963; *Agriolimax laevis*, L'Islet, Guernsey, G. W. Pitchford, August 1963.

Scilly (1a): *Arion lusitanicus*, Mrs S. M. Turk, 1964.

Cornwall West (1): *Theba pisana*, The Island, St Ives (confirmation of old record), Mrs S. M. Turk, 1964; *Arion lusitanicus*, St Just-in-Penwith, A. E. Ellis, August 1964.

Devon South (3): *Arion lusitanicus*, Alphington; *Arion rufus*, Cheriton Bishop, both A. E. Ellis, October 1964.

Dorset (9): *Arion rufus*, near Chapman's Pool, J. B. Hall, August 1964.

Sussex West (13): *Carychium tridentatum*, Newtimber Hill, J. B. Hall, June 1963.

Kent East (15): *Arion rufus*, Wye and Crundale nature reserve, J. B. Hall, July 1964.

Bucks (24): *Cochlicopa lubricella*, Brill, J. G. Evans, February 1965.

Warwick (38): *Arion rufus*, Nuneaton, A. J. Cain & M. Williamson, September 1954.

Salop (40): *Carychium tridentatum*, *Cochlicopa lubricella*, *Vertigo pygmaea*, Halford, M. P. Kerney, March 1964.

Caernarvon (49): *Pomatias elegans*, Great Ormes Head, J. F. Harper, April 1964.

Denbigh (50): *Cochlicopa lubricella*, Ffynnon Fair, near Cefn, C. F. Wright, 1963.

Flint (51): *Cecilioides acicula* (dead shell), Caerwys, J. O'N. Millott, 1964.

Anglesey (52): *Phytia myosotis*, Holy Island, J. F. Harper, April 1964; *Milax budapestensis*, Penmon Priory, J. B. Hall, April 1964.

York South-west (63): *Milax budapenstensis*, Cowling, D. G. Pickrell, 1963.

Kirkudbright (73): *Limax cinereoniger*, Newton Stewart, T. Huxley, 1960.

Ayr (75): *Anodonta anatina*, River Irvine, Revd E. J. McMurtrie, before 1880. Specimens in Royal Scottish Museum, Edinburgh, *det.* A. R. Waterston. Recorded by Rimmer as '*Anodonta cygnea*, var. *incrassata*' (*Land & Freshwater shells of the British Isles*: 17 (1880)).

Renfrew (76): *Anodonta anatina*, Ryat Reservoir, J. D. Morton, 1960. Erroneously recorded as *A. cygnea* (*Glasg. Nat.* **18**: 376) but verified as *A. anatina* by A. R. Waterston and M. P. Kerney.

Westerness (97): *Vertigo lilljeborgi*, north end of Loch Oich, D. K. Kevan, August 1935; *Cochlicopa lubricella*, Aberchalder, Loch Oich, F. May, August 1960.

Ebudes South (102): *Potamopyrgus jenkinsi*, *Bithynia tentaculata*, *Lymnaea truncatula*, *Planorbis contortus*, *Succinea pfeifferi*, *Cochlicopa lubricella*, *Vertigo pygmaea*, *Pupilla muscorum*, *Hygromia striolata*, *Milax budapestensis*, *Pisidium casertanum*, *Pisidium personatum*, Islay, Mrs N. F. McMillan, June 1964.

Outer Hebrides (110): *Hydrobia neglecta*, Loch an Strumore, North Uist, T. Warwick, March 1964.

Galway North-east (H. 17, or 140): *Planorbis vortex*, Lough Callow, near Killconnell, A. W. Stelfox, September 1928 (*per* D. K. Kevan).

Wicklow (H. 20, or 126): *Vertigo moulinsiana*, in the 'Murrough', 5 miles N. of Wicklow, A. W. Stelfox, August 1954.

Dublin (H. 21, or 124): *Cochlicopa lubricella*, Killiney Park, A. W. Stelfox, August 1921.

Down (H. 38, or 115): *Vallonia excentrica*, Millisle, A. W. Stelfox, August 1912.

Derry (H. 40, or 113): *Cochlicopa lubricella*, *Vallonia excentrica*, Magilligan, R. Macdonald, September 1937.

Most important is the recognition from North Uist and probably from the Channel Islands of *Hydrobia neglecta* Muus, a species recently described from Denmark (*Proc. malac. Soc. Lond.* **35**: 131 (1963)). *H. neglecta* is most closely allied to *H. ventrosa*, but shows clear differences in both ecology and morphology. Also noteworthy are the new records of *Arion lusitanicus* from Scilly, Cornwall and Devon (*J. Conch.* **25**: 285, 345), a slug which may well prove more widespread than has hitherto been suspected, having previously been confused with both *Arion ater* and *A. rufus*. Interesting extensions to known ranges are *Pomatias elegans* from Caernarvon, *Anodonta anatina* from Renfrew and Ayr, *Vertigo moulinsiana* from Wicklow, and *Planorbis vortex* from Galway North-east.

Both *Vitrea crystallina* s.s. and *V. contracta* (*J. Conch.* **25**: 276) are proving to be common species in Britain. Specimens have been verified from the following vice-counties:

Vitrea crystallina: 1, 2, 17, 20, 24, 32, 40, 51, 57, 58, 59, 62, 63, 64, 88, 97, H. 2, H. 4, H. 12, H. 17, H. 20, H. 27, H. 29, H. 38, H. 40.

Vitrea contracta: 1a, 1, 2, 16, 17, 40, 49, 57, 58, 59, 60, 62, 64, 97, 100, 111, H. 1, H. 4, H. 17, H. 18, H. 27, H. 29, H. 38, H. 40.

B. 10 Kilometre Square Mapping

Records continue to trickle in, but I should be glad to hear from further members who would like to help, particularly those in a position to collect from 10 kilometre squares in acid or otherwise unattractive areas, which have hitherto been badly neglected. Offers to extract literature, or list museum material, would also be much appreciated. About 30,000 records have so far been incorporated in the scheme, but I estimate that a number approaching 200,000 will be necessary before it will be possible to construct meaningful maps for the commoner species.

I am especially indebted during the past year to Mr D. K. Kevan, who very kindly provided me with the full results of his field work on the Mollusca of Scotland from 1929 onwards.

M. P. Kerney

Recorder's Report: marine Mollusca

The slight decrease in the number of specimens submitted for authentication last year enabled the Recorder to catch up on the back-log, and almost all the Voucher Collection has now been transferred to the Natural History Museum. Consequently, the first provisional list of Category A records, for the areas 11–20, has been brought up to date and is now ready for distribution. A preliminary note on the Society's marine Census appeared in the December 1964 issue of *Triton*, while a more detailed account of collecting living Mollusca in the sublittoral zone is being prepared by Mr C. W. Pettitt for the same magazine. It is to be hoped that scientifically minded skin-divers will make a substantial contribution to the records in the coming summers.

Perhaps the most interesting material to be added to the Voucher Collection during the year was collected by the marine Recorder who, thanks to the kind invitation of Mr N. A. Holme of the Marine Biological Laboratory, Plymouth, was able to spend a fortnight during the summer on the R.V. 'Sarsia' dredging in the Celtic Sea between the Scilly Isles and the south of Ireland. Most of the specimens were taken by anchor dredge in Area 40 [Sole], but others, including numerous examples of the squid *Todaropsis eblanae* (Ball), were taken by otter-trawl, or from adjacent areas. A few stations were worked beyond the 100 fm line in the North Atlantic Area, from which many interesting species were dredged including live specimens of the deep-water turrid *Spirotropis carinata* (Philippi) and the solenogastre *Proneomenia aglaopheniae* (Kovalevsky and Marion) *in situ* on the hydroid *Thecocarpus myriophyllum* (L.). Much of the dredged material is still unsorted, but it is hoped that it will prove of sufficient interest to furnish an account of the Mollusca of this little collected region of the British Area in a subsequent number of the *Journal*.

Later in the summer a single specimen of *Lamellaria latens* (Müller) was taken at Birsay, Orkney Mainland, by the Recorder while collecting in the company of Mr ROBERT RENDALL. This was the first record of the species from that area. While at Orkney the opportunity was taken to visit Congesquoy, the locality from which WINCKWORTH recorded a giant race of cockles in 1921 (*J. Conch.* **16**: 157). Very large specimens of *Cerastoderma edule* (L.) were found still to inhabit this locality, though in small numbers, and more giant-sized specimens up to 7 cm across were later found in Scapa Bay by Mr E. KELLOCK.

As in previous years, my report concludes with some recent additions and emendations to the British list:

Tonicella rubra (L.) was recorded as new to Cornwall by TURK, 1964 (*The Lizard* **2** (4): 8). Unfortunately the specimen on which the record was based proved on subsequent re-examination to be another species.

Rissoacea. A proposed revision of the families Rissoidae, Rissoinidae and Cingulopsidae has been published by COAN, 1964 (*Veliger* **6**: 164–171). So far as the British genera are concerned, the most notable innovations are the establishment of a new subfamily Cingulinae for the genus *Cingula* and the transfer of *Barleeia* to a subfamily Barleeinae of the family Rissoinidae. The subgenus *Manzonia* is transferred from *Alvania* to *Rissoa*. MOORE, 1962 (*Bull. mar. Sci. Gulf Caribb.* **12**: 695–701), has already shown that, on anatomical grounds, the family Caecidae should be transferred from the Cerithiacea to the Rissoacea. A much-needed illustrated key to the British rissoids is being prepared by Mrs S. M. TURK and, it is hoped, will be published in the *Journal* in the near future.

Pneumodermopsis. COOPER & FORSYTH, 1961 (*Nature, Lond.* **191**: 1412), 1963 (*Bull. mar. Ecol.* **6**: 31–38), record the distribution of this pteropod in the British area. To quote them: '*Clione limacina* Phipps is the only gymnosomatous pteropod normally found in the North Sea, but *Pneumodermopsis ciliata* Gegenbaur has been recorded occasionally from Shetland waters. In 1960, however, *P. paucidens* Boas was recognized for the first time in the North Sea. . . . Previously this species has been recorded only from the North Atlantic and off the coast of Ireland.'

Pseudovermidae. Three specimens closely resembling *Pseudovermis schulzi* Marcus & Marcus, of a nudibranch family new to Britain, have been reported by BOADEN, 1961 (*Nature, Lond.* **191**: 512) from sand at Traeth Bychan, on the east coast of Anglesey.

Turtonia minuta (Fabricius). The systematic position of this minute littoral bivalve has always been in doubt, having been placed variously in the superfamilies Cyamiacea and Erycinacea. OCKELMANN, 1964 (*Ophelia* **1**: 121–146), has demonstrated that the species exhibits strong affinities with the Veneracea, particularly with the spat of *Venerupis*, and it is concluded that *Turtonia* should be included in the Veneracea close to *Venerupis* and that it has evolved from a *Venerupis*-like ancestor by a process of neoteny.

Ensis. VAN URK, 1964 (*Basteria* **28**: 13–44), has reviewed the genus *Ensis* in Europe, establishing two new species—*E. phaxoides* and *E. sicula*—and three new varieties. *E. minor* (Chenu) is also regarded as a good species. *E. minor* and *E. phaxoides* are both considered to occur in the British fauna.

Additions to the Official Lists. When the ICZN placed volume **3** of OKEN's *Lehrbuch der Naturgeschichte* on the *Official Index of Rejected Works* in 1956 (Opinion 417), a number of familiar molluscan generic names became invalid. One of these, the nudibranch *Doto*, has now been restored to validity by the Commission (*Bull. zool. Nom.* **21**: 97–100), with *Doris coronata* Gmelin, 1791 designated as type-species under the plenary powers (Opinion 697). This species and [*Melibaea*] *fragilis* Forbes, 1838, both of which occur in Britain, are placed on the *Official List of Specific Names*. The correct form of the family name has been officially determined to be 'Dotidae'. In Opinion 714, MÖRCH's work of 1852–53, generally known as the 'Yoldi Catalogue' is placed on the *Official List of Works*. This action validates the generic name *Pseudamussium*, the status of which was hitherto in doubt, and this and its type-species *Pecten septemradiatus* Müller, 1776, are also placed on the appropriate *Official Lists* (*Bull. zool. Nom.* **21**: 355–356).

DAVID HEPPELL

Field Meetings

As in 1963, seven field meetings were held during 1964. On Sunday 26 April, Abberton Reservoir, Essex, was visited under the guidance of Mrs J. LLEWELLYN JONES, to examine the freshwater fauna of a typical inland lake Bird Sanctuary; then East Mersea for the seashore and salt marshes, with brackish-water fauna. Norbury Park Woods, Mickleham, Surrey, were visited on Saturday 9 May (director Mr A. E. ELLIS), to study the chalk woodland fauna; nearly forty species of Mollusca are recorded from this locality. Sunday 31 May was the occasion of a joint meeting with the Geologists' Association at Walton-on-the-Naze, Essex, under the joint direction of Mr P. CAMBRIDGE and Mr J. COLLINS, to examine and collect from the Red Crag (Lower Pleistocene) shelly sands. These beds are extremely fossiliferous and the large party enjoyed a most instructive and profitable day. On Saturday 20 June, under the direction of Mr D. G. PICKRELL, a visit was paid to Leith Hill, Surrey, the party walking from Abinger to Leith Hill by way of Friday Street (pond) and Wotton Common (stream and woods). For the purpose of recording for the 10-kilometre-squares Census of non-marine Mollusca, Albury, near Guildford, Surrey, was visited on Sunday 26 July (director Miss J. CHATFIELD), and Shoreham and Eynsford, Kent, on Sunday 4 October (director Dr M. P. KERNEY), in order to collect land and freshwater Mollusca from a varied series of calcareous environments. The final meeting of the year was held at Sandling, Kent, under the direction of Miss J. CHATFIELD, on Saturday 24 October, during which a visit was paid to the Royal Military Canal at Hythe.

The Field Meetings Organizer wishes to express grateful thanks to all who arranged and led these meetings and whose co-operation makes a continuance of these activities possible.

T. PAIN

Votes of Thanks

Votes of thanks were approved to the Trustees of the British Museum (Natural History), to the Catering Manageress and Staff, and to the Officers and Council.

Presidential Address

The President delivered an address entitled 'Snails and Man in Britain'.

Election of Officers and Council

The Officers and Council were declared elected, as shown on page 315 of volume 25.

Exhibits

Mrs A. M. BROCKBANK: a large number of *Aequipecten* found in a fish in Loch Ewe, Ross and Cromarty.

Mr P. CAMBRIDGE: *Neptunea* spp., Lower Pleistocene to Recent, illustrating the evolution of the genus in the North Sea basin.

Mr C. P. CASTELL: specimens of British fossil non-marine Mollusca from the British Museum collections to illustrate Dr KERNEY's address.

Mrs N. F. McMILLAN: photographs and conchological leaflets of FREDERICK PRICE MARRAT (1820–1904).

Mr T. PAIN: fossil *Placostylus* from New Caledonia, Isle of Pines and Loyalty Islands.

Mr C. R. C. PAUL: subspecies of *Pseudachatina wrighti*.

Mr R. P. SCASE: *Cypraea* (*Cribraria*) *catholicorum* Schilder & Schilder, Ataa, Malaita, Solomon Islands, with *C. cribellum* Gaskoin, Mauritius, and *C. gaskoini* var. *fischeri* Vayssière, Hawaii, for comparison; a rare red variety of *Voluta* (*Amoria*) *maculata* Swainson, trawled in 64 fathoms off Tin Can Bay, Queensland; rare deep water *Conus* from the eastern coast of Australia: *C.* (*Floraconus*) *angasi* Tryon, off Tweed Heads, N.S.W., 60 fathoms; *C.* (*F.*) *wallangra* Garrard, off Cape Moreton, Queensland, 40 fathoms; *C.* (*Dauciconus*) *kermadecensis* Iredale, off Southport, Queensland, 40 fathoms; *C.* (*Leptoconus*) *sculletti* Marsh, off Cape Moreton, 100 fathoms.

Mrs T. P. WHITEHEAD: *Conus iodostoma* Reeve, Sudi Bay, Mtwara, Tanzania.

821st Meeting, held at the British Museum (Natural History), 13 March 1965

The President, Dr M. P. Kerney, in the Chair.

Members Elected

Sgt R. W. Armes, R.A.F., 49 Pinewood Square, St Athan, Barry, Glamorganshire.
J. Armitage, City Museum, Park Row, Leeds 1, Yorkshire.
Mrs R. M. Giovanelli, 19 Auburn Road, Onchan, Isle of Man.
J. B. Hawthorne, B.Sc., M.I.Biol., 188 Preston Road, Preston, Weymouth, Dorset.
A. Norris, City Museum, Park Row, Leeds 1, Yorkshire.
Scottish Marine Biological Association, Millport, Isle of Cumbrae, Buteshire, Scotland.
Dr J. C. Smyth, Glenpark, Johnstone, Renfrewshire, Scotland.

Communications

'The rediscovery of *Theba pisana* (Müller) in Cornwall', by Stella M. Turk.
'*Arianta arbustorum* (L.) living with *Helix nemoralis* L. on blown sand', by N. F. McMillan.
'*Margaritifera margaritifera* (L.) in hard water in Scotland', by N. F. McMillan.

Exhibits

Special exhibit: British Eocene Mollusca, introduced jointly by Mr C. P. Castell and Mr P. E. Negus who exhibited a representative selection of specimens and literature, including some from the British Museum collection; specimens were also shown by Mr L. W. Stratton.

Mr T. Pain: British fossil Viviparidae.

Mr D. G. Pickrell: Mollusca of the London Clay and Paris basin.

Mr C. A. Raffray: sectioned marine gastropods.

Mr R. P. Scase: Mollusca from the Eocene and other Tertiaries, with literature.

822nd Meeting, held at the British Museum (Natural History), 10 April 1965

The President, Dr M. P. Kerney, in the Chair.

Members Elected

William F. Davidson, F.G.S., 9 Castlegate, Penrith, Cumberland.
Thomas H. S. Kemp, 9 Redruth Road, Harold Hill, Romford, Essex.
H. Scaff, 53 rue Sualem, Jemeppe sur Meuse, Belgium.
Mrs Vera Warner, Oakfield, Ewhurst, Surrey.
Whitelands College, West Hill, Putney, London S.W.15.
D. A. V. Williams, B.A., 7 Lansdowne Mews, London W.11.

Communications

'A curious monstrosity of *Helix aspersa* Müller', by M. R. Block.
'Two new species of *Hydrocena* from Sabah, Borneo', by W. S. S. van Benthem Jutting.
'A note on *Conus sowerbyi* Reeve, 1849', by W. O. Cernohorsky.

Exhibits

Special exhibit: land operculates of the New World, introduced by Mr T. Pain who exhibited many specimens from Jamaica, Cuba and elsewhere; Cuban operculates were also shown by Revd H. E. J. Biggs, and Mr L. W. Stratton brought a display of the pulmonate *Polymita picta* (Born).

Mr F. M. J. Pinn: Gault ammonites from Folkestone.

Mr G. W. Pitchford: marine shells from Co. Londonderry, Co. Antrim and Co. Down, Northern Ireland; a photograph of Members of the Conchological Society attending the Annual General Meeting of 1904*; some specialized collecting gear.

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* See *J. Conch.* **11**: frontispiece (issued with No. 5).

823rd Meeting, held at the British Museum (Natural History), 15 May 1965

The President, Dr M. P. Kerney, in the Chair.

Member Deceased

The President reported the death of Mr C. J. Gabriel.

Members Elected

Miss H. M. Burkitt, 70 Beaufort Mansions, Beaufort Street, London S.W.3.
Mrs Jean Lavinia Charlish, B.Sc., 22 Ednam Road, Goldthorn Park, Wolverhampton, Staffordshire.
William Foulkes Edwards, 31 Westminster Road, Failsworth, Manchester, Lancashire.
Trevor Maurice Knight, 30 Campfield Road, St Albans, Hertfordshire.
Kenneth Jones, Seaspray, Quay Road, St Agnes, Cornwall.
Edmund Hobart Smith, M.A., Ph.D., Director, Pacific Marine Station, Dillon Beach, Marin County, California 94929, U.S.A.
Mrs Kathleen Rosemary Smythe, 6 Blondell Drive, Aldwick, Bognor Regis, Sussex.
William Stevens-Jones, 3 Manor Hill, Birkenhead, Cheshire.
William Edmund Thomas, 8 Pencefnarda Road, Penyrheol, Gorseinon, Swansea, Glamorganshire.

Communications

'Cultivation of the black-lip pearl oyster, *Pinctada margaritifera* (L.)', by William Reed.

'The status of *Pisidium hibernicum* Westerlund', by J. G. J. Kuiper.

'The distribution in Ireland of very dark forms of *Cochlicella acuta* (Müller)', by A. W. Stelfox and N. F. McMillan.

'*Physa acuta*, an introduced species new to South Africa', by A. C. van Bruggen.

Exhibits

Special exhibit: Tellinacea, introduced by Miss J. Chatfield who exhibited specimens of the British species; British and foreign tellinids were also shown by Major P. K. Earle and Mr L. W. Stratton; Mr T. Pain exhibited specimens of *Egeria congica* (Donacidae).

Revd H. E. J. Biggs: samples of *Trichia* species in connexion with the taxonomic changes proposed by Forcart, 1965 (see *Proc. 1st Europ. malac. Cong.*: 79–93); a specimen of *Mytilus edulis* in its third year, taken from the chela of a crab.

Mr C. P. Castell: *Quartärmollusken der Tschechoslowakei*, by V. Ložek, 1964. *Rozpravy Ústředniho stavu geologického* **31**. pp. 374, 32 pls. (*c.* 200 figs.), 91 text-figs. Text in German. [Descriptions of species and keys to many genera; general account of quaternary stratigraphy and faunistic lists; many British species are dealt with; nothing like it for this country.]

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CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

Annual Subscriptions (£2) fell due on 1 January and Members who have not already done so are urged to remit to the Hon. Treasurer without further delay. Those whose subscriptions are in arrears by more than one year cannot expect to receive copies of the *Journal*. Please make sure that your remittance fully covers the subscription or the total amount due. No receipt will be sent for any subscription paid by cheque on a United Kingdom bank, unless specially requested. It is essential that cheques should be made payable to the *Conchological Society of Great Britain and Ireland* and not to the Treasurer by name.

Members are requested to notify the Hon. Secretary promptly of any change of address.

Papers intended for publication in the *Journal of Conchology* must be sent to the Hon. Secretary, and NOT to the Hon. Editor. A copy should always be retained by the author.

MALACOLOGICAL SOCIETY OF LONDON

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THE JOURNAL OF CONCHOLOGY

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OF GREAT BRITAIN AND IRELAND

CONTENTS

PAGE
Officers and Council for 1966–67 83
DAVID HEPPELL—The dates of publication of J. D. W. Hartmann's 'Erd- und Süsswasser-Gasteropoden' 84
W. O. CERNOHORSKY—The mitrid genera and species established by P. F. Röding in the 'Museum Boltenianum' 89
JOHN BOWDEN & DAVID HEPPELL—Revised list of British Mollusca. 1. Introduction; Nuculacea—Ostreacea 99
L. M. COOK—Notes on two colonies of *Cepaea nemoralis* (L.) polymorphic for white lip . 125
FRANZ ALFRED SCHILDER & MARIA SCHILDER—Statistics in North-West American *Pusula* Jousseaume (Triviidae) 131
NORA F. MCMILLAN—Kennard's record of fossil *Helix nemoralis* L. in Orkney . . 135
H. E. J. BIGGS—A new species of *Littorina* from Eilat, Israel, and notes on its affinities with *Littorina novaezelandiae* Reeve 137
J. W. STEPHENSON—Notes on the rearing and behaviour in soil of *Milax budapestensis* (Hazay) 141
Reviews 140, 146
Proceedings: 16 October 1965, 13 November 1965, 11 December 1965 (Special General and Ordinary Meetings), 22 January 1966 147
Changes of Address 150

PLATES 6–8

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J. Conch. **26**: 84–88. (1966)

THE DATES OF PUBLICATION OF J. D. W. HARTMANN'S 'ERD- UND SÜSSWASSER-GASTEROPODEN'

David Heppell
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(*Read before the Society*, 12 *December* 1964)

J. D. Wilhelm Hartmann von Hartmannsruthi, sometime natural history artist to Prince Maximilian von Wied, wrote a number of works on Swiss non-marine Mollusca, the most important being the *Erd- und Süsswasser-Gasteropoden*, which was published in parts by Scheitlin & Zollikofer in St Gallen between 1840 and 1844. The year of publication of the early parts has remained in doubt not so much from lack of information as from discrepancies in the data given by 'usually reliable sources'.

Woodward (1906) based the dates of issue of the first seven parts (Hefte) on notices of publication in Oken's *Isis*, and that of the final Heft on information in Engelmann's *Bibliotheca Historico-Naturalis* (1846). The date '1840' given by Oken for the publication of Hefte 3 and 4 was considered by Woodward to be an 'obvious misprint' and was corrected by him to 1841. Sherborn (1922), in the Bibliography to his *Index Animalium*, gave the same dates for the Hefte as Woodward, but the contents of each Heft as given by him are completely different. A further discrepancy is that Sherborn stated the work to be in quarto, while Woodward gave it as octavo. Sherborn did not give the source of his information concerning the contents of the Hefte, but in a copy of this work in the library of the British Museum (Natural History)—the copy used by both Sherborn and Woodward—there is a note in Sherborn's handwriting on the fly-leaf which reads:

'Parts 1 & 2	pp. 1–50	pls. 1–12	1840
3 & 4	51–100	1–12, 1–12	1841
5 & 6	101–172	[37–60]	1842
7	173–196	[61–72]	1843
8	197–227	[73–84]	1844

'I have not seen the original parts, but this must be very near the truth according to Wiegmann's Archiv.'*

At a later date, pp. '50' and '51' have been crossed through and '44', '45' substituted, and '& Syst. Übers.' has been added to the contents of part 1. Surprisingly, Woodward (1922) subsequently disregarded his own earlier findings and adopted the more tentative ones of Sherborn.

In view of this confusion, it seemed desirable to review contemporary sources of information to determine, in particular, the contents of Hefte 1 and 2 and the dates of publication of Hefte 3 and 4, the 'Systematische Übersicht', and pp. i–xx.†

Hefte 1 and 2

Oken's *Isis* was issued, during the period under consideration, in monthly parts, the notice of publication of the commencement of Hartmann's work appearing in Heft 6 for 1840. It is evident from this that the first two Hefte were on sale not later than June of that year and, according to Oken, 37 text-pages and 12 plates were included. Froriep & Froriep (1842) state: '6 schön

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[*] Wiegmann's *Archiv für Naturgeschichte* appeared twice a year, the later part being devoted to systematic reviews of the literature published during the preceding year. All eight Hefte of the *Erd- und Süsswasser-Gasteropoden* were reviewed by Troschel (1841–44) who gives an outline of the contents of each Heft though, unfortunately, not in sufficient detail to permit an accurate assessment of its pagination.

[†] An effect of this disagreement may be illustrated by reference to the genus *Trichia*. This name has been regarded by most authorities as first validly published on p. 41 of this work. According to Woodward (1906) this page is included in Heft 3, published in 1841; Sherborn (1922) included it in Hefte 1 + 2, published in 1840; Zilch (1960) included it in Heft 3, but dated that part from 1840. The confusion is worsened by the fact that Woodward subsequently disregarded his own findings in this respect and gave the date of *Trichia* as 1840 (Kennard & Woodward, 1926). Boettger (1928) noted this, and suggested that Oken's date for Hefte 3 and 4 might have been correct after all. In fact, *Trichia* should be dated from its occurrence on p. xiii, where the following footnote occurs: 'Seiher scheint Schmidt ebenfalls Bastarderzeugungen für möglich zu halten. Ich nehme es bei *Trichia hispida* et *sericea*, und bei einigen Clausilien für bestimmt an, halte es aber vorzüglich bei Wasserschnecken für öfter vorkommend'. I had at first regarded this occurrence of the name as a nomen nudum, as the authors of the two specific names mentioned are not given, but now defer to the opinion of Dr L. Forcart (*in litt.*) that the identity of the species is sufficiently clear from the context to satisfy the criteria of availability [ICZN Articles 12, 16(a) (v)]. In his excellent discussion of the type-species of *Trichia*, Boettger (1928) mentioned the designation of *Helix hispida* L. by Herrmannsen, 1849, but regarded that designation as invalid as he dated p. xiii from 1844, i.e. three or four years after the publication of p. 41. Herrmannsen's designation is, however, the earliest valid type-designation for *Trichia* Hartmann as pp. i–xx were published before p. 41, as will be shown below. The type-species of *Trichia* must, therefore, be *Helix hispida* L., 1758.

col. Kupfer das Heft', but that seems to be an unwarranted and inaccurate assumption. In the British Museum (Natural History) is a second copy of this work, presented to the Museum by G. K. GUDE but originally a presentation copy from HARTMANN to 'Herrn C. GIRTANNER Med. Doctor', which consists only of the following: original wrapper for Heft 1, pp. [i]–xx, [1]–36, Systematische Übersicht, pls. I–XII. On the wrapper it is stated that 3–4 Hefte will be published annually. The 'Systematische Übersicht der Europäischen Gattungen' is a single unnumbered page bound in before the plates. The title-page is dated 1840. This appears to be a copy of Hefte 1 and 2 in original condition, and proof that pp. i–xx and the Systematische Übersicht were an integral part of it.* Confirmation is provided by a contemporary book catalogue (KAYSER, 1841) which states: 'Mit 1 Tab. u. 12 Kpfrtaf.'. From this source we can also deduce the contents of the first two Hefte, as the entry continues:

'Heft I . . . . $1\frac{1}{3}$ Thaler.
—— dass[elbe] mit 12 sauber ausgemalten Tafeln, oder Heft I u. II
. . . . 3 Thaler'.

In a later volume (KAYSER, 1848), the price of the complete work is given as $9\frac{1}{3}$ Thaler for the text alone or 21 Thaler complete with coloured plates, i.e. seven, not eight, times the price of a single Heft.

Both copies of the *Erd- und Süsswasser-Gasteropoden* in the British Museum (Natural History) are in quarto, as are the copy in the British Museum library and four copies in Switzerland (one in the possession of Dr L. FORCART, one in Basle University Library, and two in the library of the Naturhistorisches Museum in Basle, one of which is incomplete and contains only the title-page, pp. [i]–viii, and pls. 1–60). The small page-size of 17 cm × 25·5 cm is the likely explanation of the work being listed as octavo in many catalogues. As pp. xvii–2 are printed on the same sheet, pp. i–xx must have been issued as part of Heft 1.† Although the 'Systematische Übersicht' was also issued with Heft 1 and is obviously the page '37' of OKEN's notice, it was apparently printed on a separate sheet as it is bound up differently in different copies.

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* On p. 227 of the *Erd- und Süsswasser-Gasteropoden* the following note appears: 'Am Ende des zweiten Bandes soll noch ein systematisches Verzeichniss über sämmtliche Abbildungen und eine besondere Uebersicht der Abnormitäten geliefert werden'. Some authorities have assumed this to refer to the 'Systematische Übersicht' and, as the proposed second volume never appeared, that it was issued as a separate sheet at a later date.

† An 'Inhalt' of two unnumbered pages comes between p. xx and p. [1], and pp. 3–4 appear to be printed on a separate leaf as signature 4 begins with p. 5. The signatures run from 1 to 31 in *one continuous sequence*. This is possible evidence that the quarto edition is a reprinting of an original octavo edition as, normally, preliminary matter such as pp. i–xx is printed after the completion of the main part of the text and must be separately signatured, so that signature [1] would coincide with page 1. In this case, signature [1] occurs on p. [i] with p. 1 coming between signatures 3 and 4. All contemporary notices of publication of the work refer to the format as large octavo and ENGELMANN (1846) actually stated '$17\frac{1}{2}$ Bog. Text'. If we assume a new signature for the first page of each Heft, using the pagination indicated by OKEN, we find that an octavo edition of the text, exclusive of the twenty prefatory pages, requires 17 signatures, the last gathering being a half-sheet. In such a postulated 'page for page' octavo edition, then, pp. i–xx would not form part of Heft 1 but would have been issued at a later date and presumably not earlier than 1844. But Heft 1 of the quarto edition *containing these pages* was catalogued in the British Museum library on 11 May 1843! Thus until convincing evidence to the contrary is forthcoming, the octavo edition must be regarded as a 'ghost'.

HEFTE 3 AND 4

WOODWARD was correct in assuming OKEN's date '1840' to be a misprint as TROSCHEL (1842) definitely states that these two parts were published in 1841, each with twelve plates. Both sets of plates were numbered I–XII.

HEFTE 5 TO 8

The numbering of the plates is irregular in these parts, and is as follows: 37–47, XII, II, 50–60, X, VII, 63–84. The arrangement is identical in both the British Museum and British Museum (Natural History) copies, and where plates with roman numerals occur in Heft 3 onwards the correct plate numbers in arabic numerals have been added in a hand apparently that of the author. Heft 8 was the final part of volume 1 and with it was issued a covering title-page dated 1844 which bears a more extended title than that of 1840: '*Erd- und Süsswasser-Gasteropoden der Schweiz*', to which is added: 'Mit zugabe einiger merkwürdigen exotischen Arten'. The proposed volume 2 (referred to on pages 189 and 227) did not appear.

SUMMARY

J. D. W. HARTMANN's *Erd- und Süsswasser-Gasteropoden* was published in eight parts between 1840 and 1844 in a quarto edition. Evidence for an octavo edition seems to be spurious. The contents and dates of publication of the Hefte, as far as can be ascertained, are as follows:

Heft 1	pp. i–xx, Inhalt, pp. 1–36 Title-page Systematische Übersicht	1840 [not later than June]
Heft 2	pls. I–XII [1–12]	With Heft 1
Heft 3	pp. 37–60, pls. I–XII [13–24]	1841
Heft 4	pp. 61–116, pls. I–XII [25–36]	1841
Heft 5	pp. 117–148, pls. 37–47, XII [37–48]	1842
Heft 6	pp. 149–156, pls. II, 50–60 [49–60]	1842
Heft 7	pp. 157–204, pls. X, VII, 63–72 [61–72]	1843
Heft 8	pp. 205–227, pls. 73–84 [73–84] Title-page	1844

ACKNOWLEDGMENTS

I am most grateful to Dr L. FORCART for information about copies of this work in Swiss libraries and for his valued opinion on the status of the name *Trichia* in Heft 1, and to Dr J. BOWDEN for reading the manuscript and for making helpful comments and criticism; the assistance of the librarians of the British Museum and British Museum (Natural History) is also gratefully acknowledged.

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J. Conch. **26**: 89–98. (1966)

THE MITRID GENERA AND SPECIES ESTABLISHED BY P. F. RÖDING IN THE 'MUSEUM BOLTENIANUM'

W. O. CERNOHORSKY
Vatukoula, Fiji Islands

(*Read before the Society*, 13 *November* 1965)

INTRODUCTION

The *Museum Boltenianum sive Catalogus cimeliorum e tribus regnis naturæ quæ olim collegerat Joa. Fried. Bolten, M.D. p.d.* appeared in two parts, and it is part 2 which contains the list of molluscan univalves, bivalves and multivalves. The work was published by JOHAN. CHRISTI. TRAPII in Hamburg, but no date of publication appears on the fly-leaf. Pages III–VI contain a Latin Introduction by AUG. HENR. LICHTENSTEIN which is dated 10 September 1798: this date should be accepted as the earliest date of publication in the absence of further evidence to the contrary. LICHTENSTEIN's Introduction is followed by PETER FRIEDRICH RÖDING's 'Vorrede',* in which he praises the magnificent collection of Mollusca of the late J. F. BOLTEN, containing almost 7,000 univalves and close to 1,300 bivalves and multivalves. The author also expressed his sentiments over a possible dispersal of the collection, and hoped that BOLTEN's family would soon find a buyer for this splendid collection of shells, most of which had been cleaned of sea-growth by expert hand.

As no buyer was found for the entire collection, it was offered for sale by auction in 1819, for which event a second edition of the *Museum Boltenianum* was published by JOHANNES NOODT in January, 1819. This second edition was essentially the same in text as the 1798 edition (including the list of mineralogical specimens which are presumed to have formed part 1 of the first edition) and comprised four unpaged leaves, 156 pages and four plates (DALL, 1915). These plates, which were executed by J. J. NOODT and printed in reverse, validated some of the names which were nomina nuda in the first edition (IREDALE, 1921).

RÖDING's listing of BOLTEN's collection was based on the 13th edition of the *Systema Naturae* (GMELIN, 1791), the collection of Gastropoda being arranged in 82 drawers and the Pelecypoda and Polyplacophora in 38 drawers.* The species are numbered in the left-hand column and the Latin names are followed by their German vernacular equivalents. The BOLTEN collection of Mitridae consisted of about 170 specimens, comprising 49 species according to RÖDING's classification; this represents only about 8% of all known Recent mitrid species. RÖDING established three new mitrid genera and listed forty-nine mitrid specific names. Of these, five are Linnaean species, three are Gmelin species, twenty-three names are newly introduced and validly established and eighteen are nomina nuda. Of the twenty-three validly established names, eighteen are synonyms of previously established species, one [*Mitra perlata*] is a nomen oblitum and four species [*M. imperialis*, *M. bernhardina*, *M. eremitarum* and *M. praestantissima*] are validly established for the first time.

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* The authorship of the *Museum Boltenianum* has often been credited to BOLTEN, but it is quite clear from the introduction that the work was commenced by RÖDING after BOLTEN's death, and that RÖDING alone is responsible for any new names established in this work [ICZN Direction 48].

MÖLLER (1832: col. 127) recorded the acquisition by the 'Kunst- und Naturalien-Cabinet zu Gotha' of the large shell collection amassed by F. C. SCHMIDT, and stated that SCHMIDT's collection included specimens purchased at the BOLTEN auction of 1819. My enquiries as to the whereabouts of BOLTEN's molluscan collection were, accordingly, directed to the Staatliche Museen zu Gotha (Naturkundemuseum) in Gotha. The reply received from Dr MOTSCHMANN, the Director of the Museum, was as follows: 'According to the catalogue (no. 14) the SCHMIDT collection contained originally 121 species of the genus *Mitra*; thirteen of these were said to have originated from the BOLTEN Collection. The holotypes of *Mitra imperialis*, *M. eremitarum*, *M. perlata*, *Pusia bernhardina* and *Cancilla praestantissima* are not among them. In the file dealing with the conchological collection is a letter written by SCHMIDT, in which the writer claims to have acquired a great deal of material from the auction of the BOLTEN Collection. SCHMIDT did not, therefore, purchase the complete BOLTEN Collection, and the absence of the five holotypes is thus explained'.

Since the holotypes of RÖDING's species are not traceable, a search for CHEMNITZ's type-specimens might have to be instituted, as the four valid mitrid species established by RÖDING were all based on delineations in CHEMNITZ's *Conchylien-Cabinet*. Some of CHEMNITZ's type-specimens are preserved in the Zoological Museum at Copenhagen, Denmark, and the mitrid types may possibly be among them; if they can be matched to CHEMNITZ's figures, they would qualify for selection as lectotypes.

The list which follows is an arrangement of RÖDING's species of Mitridae in numerical order; the original citations are listed and the earliest valid name, with generic designation, follows RÖDING's diagnosis. The German vernacular names have been omitted since they have no standing in nomenclature. It should be noted that the author of volume 4 of the *Conchylien-Cabinet* was J. F. Chemnitz and not W. Martini as cited by Röding throughout. The fourth volume was published in 1780, and Martini died in 1778.

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* These numbers are approximate as the numbering of the drawers is somewhat irregular. In the Gastropoda drawer 50 occurs three times and drawers 51 and 56 twice each; in the bivalves and multivalves there are no drawers 5, 19, 33, 34 or 36.—Editor.

Alphabetical List of Species

[Square brackets indicate non-mitrid taxa]

[amoena, Pterygia]	655
[ancilla, Pterygia]	666
aurata, Mitra	1697
bernhardina, Mitra	1701
bivertex, Mitra	1698
caelata, Mitra	1732
caffrum, Vexillum	1747
cancellata, Mitra	1731
capucina, Mitra	1710–1
cardinalis, Mitra	1695
carmelita, Mitra	1705–6
castanea, Mitra	1715
cinnamomea, Mitra	1722
conoidea, Pterygia	671
[crassa, Pterygia]	661
crenulata, Mitra	1720
discolor, Mitra	1714
[edentula, Pterygia]	668
[effossa, Pterygia]	658
elata, Mitra	1721
elegantissima, Mitra	1723
episcopalis, Mitra	1703–4
eremitarum, Mitra	1709
[erminea, Pterygia]	656
flammeola, Mitra	1727
fossile, Vexillum	1735
[fossilis, Pterygia]	662
[fulgura, Pterygia]	665a
[glabella, Pterygia]	651
gloriosum, Vexillum	1749
granularis, Mitra	1699
imperialis, Mitra	1696
inops, Mitra	1713
laetum, Vexillum	1750
lividum, Vexillum	1737
lutea, Mitra	1712
[magellanica, Pterygia]	664
margaritacea, Mitra	1734
minuta, Mitra	1719
monachialis, Mitra	1707
[nebulosa, Pterygia]	652–3
nivea, Mitra	1718
nobilis, Mitra	1733
nucella, Pterygia	669
papalis, Mitra	1693–4
[peregrina, Pterygia]	665
perlata, Mitra	1702
[persicula, Pterygia]	660
pertusa, Mitra	1708
plicatum, Vexillum	1736
praestantissima, Mitra	1726
[pruna, Pterygia]	659
pulcherrima, Mitra	1724
pyriformis, Pterygia	670
rufum, Vexillum	1745
sanguinea, Mitra	1730
sanguisuga, Mitra	1728–9
stricta, Mitra	1700
subdivisum, Vexillum	1746
[subterranea, Pterygia]	657
superbum, Vexillum	1748
[turris, Pterygia]	663
variegatum, Vexillum	1738–44
venosa, Mitra	1717
vittata, Mitra	1716
[volva, Pterygia]	667
[vulgaris, Pterygia]	654

[Note: There is no No. 1725]

p. 51

PTERYGIA

Type-species, by subsequent designation (Dall, 1915): *Pterygia nucella* Röding, 1798 = *P. dactylus* (L., 1767).

651 *P. glabella.* Not a mitrid.
652–3 *P. nebulosa.* Not a mitrid.
654 *P. vulgaris.* Not a mitrid.
655 *P. amoena.* Not a mitrid.
656 *P. erminea.* Not a mitrid.
657 *P. subterranea.* Not a mitrid.
p. 52 658 *P. effossa.* Not a mitrid.
659 *P. pruna.* Not a mitrid.
660 *P. persicula.* Not a mitrid.
661 *P. crassa.* Not a mitrid.

662 *P. fossilis.* Nomen nudum. Not a mitrid.

663 *P. turris.* Nomen nudum. Not a mitrid.

664 *P. magellanica.* Not a mitrid.

665 *P. peregrina.* Not a mitrid.

665a *P. fulgura.* Not a mitrid.

666 *P. ancilla.* Not a mitrid.

667 *P. volva.* Not a mitrid.

668 *P. edentula.* Nomen nudum. Not a mitrid.

p. 53 669 *P. nucella.* Based on *Voluta dactylus* Gmelin, sp. 25; Lister, pl. 813, fig. 23; Chemnitz **10**, pl. 150, figs. 1411–1412 = ***Pterygia dactylus*** (L., 1767). The Lister figure has been cited by Lamarck (1811) for his *Mitra olivaria*, which is a composite species consisting of *Pterygia dactylus* (L.) and *P. nucea* (Gmelin, 1791). The Chemnitz figures have been cited by Gmelin (1791) for *P. dactylus* (L.).

670 *P. pyriformis.* Nomen nudum.

671 *P. conoidea.* Based on *Voluta conus* Gmelin, sp. 140; Chemnitz **10**, pl. 150, figs. 1415–1416 = an objective synonym of ***Pterygia conus*** (Gmelin, 1791).

p. 135

MITRA

Type-species, by subsequent designation (Winckworth, 1945): *Voluta episcopalis* L., 1758 = *Mitra mitra* (L., 1758). *Mitra* Martyn, 1784, was established in the *Universal Conchologist*, but this has no standing in nomenclature as the work is non-binominal [ICZN Opinion 456]. *Mitra* Röding, 1798, has eleven days' priority over *Mitra* Lamarck, 1798, established in the *Tableau Encyclopédique et Méthodique* on plate 369, which dates from 21 September 1798 (Cernohorsky, 1965).

1. *Anfractibus coronatis*

1693–4 *M. papalis.* Based on *Voluta papalis* Gmelin, sp. 95; Martini **4**, pl. 147, figs. 1353–1354 = ***Mitra papalis*** (L., 1758).

1695 *M. cardinalis.* Based on *Voluta papalis* Gmelin, sp. 95 var. β; Martini **4**, pl. 147, figs. 1355–1356 = secondary homonym of *Voluta cardinalis* Gmelin, 1791, and = ***Mitra stictica*** (Link, 1807).

1696 *M. imperialis.* Based on *Voluta pertusa* Gmelin, sp. 92 var. γ; Chemnitz **10**, pl. 151, figs. 1432–1433 = ***Mitra imperialis*** Röding, 1798. *Voluta digitalis* Link, 1807, and *Mitra millepora* Lamarck, 1811, are objective synonyms of Röding's species.

1697 *M. aurata*. Based on *Voluta polygona* Gmelin, sp. 62; Martini 4, pl. 150, figs. 1401–1402 = an objective synonym of ***Vexillum polygonum*** (Gmelin, 1791). *Mitra angulosa* Kiener, 1839, and *M. angulosa* Küster, 1841, are other objective synonyms of *Vexillum polygonum* (Gmelin).

1698 *M. bivertex*. Nomen nudum.

1699 *M. granularis*. Nomen nudum.

1700 *M. stricta*. Nomen nudum.

p. 136 1701 *M. bernhardina*. Based on *Voluta patriarchalis* Gmelin, sp. 138; Chemnitz **10**, pl. 150, fig. 1427 = ***Pusia bernhardina*** (Röding, 1798). Gmelin's var. β of *Voluta patriarchalis*, based on the same Chemnitz figures as Röding's species, is a different species from *V. patriarchalis*; it is the *Mitra muriculata* Lamarck, 1811, which is an objective synonym of *Pusia bernhardina* (Röding).

1702 *M. perlata*. Based on *Voluta pertusa* var. Gmelin, sp. 83 [error pro sp. 92] = ***Mitra chrysostoma*** Broderip, 1836. Röding did not cite any references to figures nor did he state to which of Gmelin's varieties his new name should be applied. By elimination, however, we can arrive at a fairly reasonable answer. For his var. β Gmelin cited Knorr, *Verg. Aug.* part 2, pl. 4, fig. 6, and for var. γ Favanne, *Conch.*, pl. 31, fig. D3 and Chemnitz **10**, pl. 151, figs. 1432–1433. The last-mentioned Chemnitz figures were cited by Röding for his *M. imperialis*, and the Favanne figure represents the same species; this eliminates Gmelin's var. γ, and Röding's *M. perlata* must, therefore, be applicable to var. β represented by the Knorr figure. There should be little doubt that the figure in Knorr (1757) represents the species *Mitra chrysostoma* Broderip; the illustration depicts a somewhat squat shell, with a moderately smooth body whorl, and 4–5 spiral grooves are indicated on the penultimate and earlier whorls. The species *M. chrysostoma* has often been confused with *Voluta mitra abbatis* Dillwyn, 1817 (homonym of *M. abbatis* Perry, 1811 = *M. stictica* Link, 1807), but this species has correctly been delineated in eighteenth-century molluscan literature as a species with prominent spiral grooves on the body whorl. From a taxonomic viewpoint it would be undesirable to introduce the earlier *M. perlata* in replacement for the better-known *M. chrysostoma* Broderip. Röding's *M. perlata*, however, qualifies as a nomen oblitum [ICZN Article 23(b)], since the name has not been used in the primary literature on the subject for fifty years. An attempt to preserve the name in mitrid nomenclature would be of no benefit to taxonomic stability.

2. *Anfractibus contiguis*

1703–4 *M. episcopalis*. Based on *Voluta episcopalis* GMELIN, sp. 94; MARTINI **4**, pl. 147, figs. 1360–1360a = ***Mitra mitra*** (L., 1758).

1705–6 *M. carmelita*. Based on *Voluta episcopalis* GMELIN, sp. 94 = ***Mitra mitra*** (L., 1758).

1707 *M. monachialis*. Based on *Voluta cardinalis* Gmelin, sp. 93; MARTINI **4**, pl. 147, figs. 1358–1359 = an objective synonym of ***Mitra cardinalis*** (Gmelin, 1791).

1708 *M. pertusa*. Based on *Voluta pertusa* GMELIN, sp. 83 [error pro sp. 92]; KÄMMERER, pl. 9, fig. 8 = a secondary homonym of *Voluta pertusa* L., 1758, which is a nomen dubium.

1709 *M. eremitarum*. Based on *Voluta pertusa* GMELIN, sp. 93 [error pro sp. 92]; MARTINI **4**, pl. 147, fig. 1361 = ***Mitra eremitarum*** Röding, 1798. *Mitra adusta* Lamarck, 1811, is an objective synonym of RÖDING's species.

1710–11 *M. capucina*. Based on *Voluta pertusa* var. GMELIN, sp. 93 [error pro sp. 92] = *Mitra pertusa* (L., 1758), a nomen dubium. GMELIN's *Voluta pertusa* contains no less than four different species and, in the absence of a figure citation by RÖDING, it is impossible to hazard a guess what species *M. capucina* represents.

1712 *M. lutea*. Nomen nudum.

p. 137 1713 *M. inops*. Nomen nudum.

1714 *M. discolor*. Based on *Voluta scutulata* Gmelin, sp. 131; CHEMNITZ **10**, pl. 151, figs. 1428–1429 = an objective synonym of ***Strigatella scutulata*** (Gmelin, 1791).

1715 *M. castanea*. Based on *Voluta nigra* Gmelin, sp. 132; CHEMNITZ **10**, pl. 151, figs. 1430–1431 = an objective synonym of ***Mitra nigra*** (Gmelin, 1791). *Mitra castanea* A. Adams, 1853, becomes a primary homonym of *M. castanea* Röding. *Turricula castanea* Garrett, 1880, however, is a *Vexillum* species and does not enter into homonymy.

1716 *M. vittata*. Nomen nudum.

1717 *M. venosa.* Based on *Voluta paupercula* GMELIN, sp. 37; MARTINI **4**, pl. 149, figs. 1386–1387 = ***Strigatella paupercula*** (L., 1758).

1718 *M. nivea.* Nomen nudum.

1719 *M. minuta.* Based on *Voluta aurantia* Gmelin, sp. 60; MARTINI **4**, pl. 150, figs. 1393–1394 = an objective synonym of ***Mitra aurantia*** (Gmelin, 1791).

1720 *M. crenulata.* Based on *Voluta crenulata* Gmelin, sp. 130; CHEMNITZ **10**, pl. 150, figs. 1413–1414 = an objective synonym of ***Pterygia crenulata*** (Gmelin, 1791).

3. *Anfractibus distinctis*

1721 *M. elata.* Based on *Voluta acuminata* Gmelin, sp. 63; MARTINI **4**, pl. 150, figs. 1403–1404 = an objective synonym of ***Vexillum acuminatum*** (Gmelin, 1791).

1722 *M. cinnamomea.* Nomen nudum.

1723 *M. elegantissima.* Nomen nudum.

p. 138 1724 *M. pulcherrima.* Nomen nudum.

1726 *M. praestantissima.* Based on *Voluta scabricula* GMELIN, sp. 48; MARTINI **4**, pl. 149, figs. 1388–1389 = ***Cancilla praestantissima*** (Röding, 1798). GMELIN's *Voluta scabricula* is a composite species consisting of *Buccinum scabriculum* L., 1758, *Cancilla praestantissima* (Röding) and *Cancilla granatina* (Lamarck, 1811). RÖDING validly separated the two CHEMNITZ figures as *Mitra praestantissima* for the species *M. filosa* auctt. (non Born). BORN's *Voluta filosa* is conspecific with *V. filaris* L., 1771.

1727 *M. flammeola.* Nomen nudum.

1728–9 *M. sanguisuga.* Based on *Voluta sanguisuga* GMELIN, sp. 50; MARTINI **4**, pl. 148, fig. 1373 = ***Vexillum sanguisugum*** (L., 1758).

1730 *M. sanguinea.* Nomen nudum.

1731 *M. cancellata.* Based on *Voluta granosa* Gmelin, sp. 136; CHEMNITZ **10**, pl. 151, figs. 1442–1443 = an objective synonym of ***Vexillum granosum*** (Gmelin, 1791). RÖDING's *M. cancellata* preoccupies *M. cancellata* Swainson, 1822, which has to be replaced by its junior synonym *M. pyramis* (Wood, 1828).

1732 *M. caelata.* Nomen nudum.

1733 *M. nobilis.* Nomen nudum.

1734 *M. margaritacea.* Nomen nudum.

VEXILLUM

Type-species, by subsequent designation (Woodring, 1928: 244): *Vexillum plicatum* Röding, 1798 = *V. plicarium* (L., 1758).

1735 *V. fossile*. Nomen nudum.

1736 *V. plicatum*. Based on *Voluta plicaria* Gmelin, sp. 55; Martini **4**, pl. 148, figs. 1362–1363 = ***Vexillum plicarium*** (L., 1758).

1737 *V. lividum*. Based on *Voluta plicaria* Gmelin, sp. 55 = ***Vexillum plicarium*** (L., 1758). *Mitra livida* Reeve, 1844, which is the plicate form of *Pusia ebenus* (Lamarck, 1811) does not enter into homonymy.

p. 139 1738 } 1739–44 } *V. variegatum* (including varieties a–f). Based on *Voluta variegata* Gmelin, sp. 89; Knorr **5**, pl. 18, fig. 6 = an objective synonym of ***Mitra variegata*** (Gmelin, 1791).

1745 *V. rufum*. Based on *Voluta variegata* Gmelin, sp. 89 = ***Mitra variegata*** (Gmelin, 1791).

1746 *V. subdivisum*. Based on *Voluta subdivisa* Gmelin, sp. 133; Chemnitz **10**, pl. 151, figs. 1436–1437 = ***Vexillum costellaris*** (Lamarck, 1811). For his *Voluta subdivisa* Gmelin cited the Chemnitz figures 1434–1437, which depict two different *Vexillum* species. Although Röding may have been aware that two different species were involved under the name *V. subdivisa*, he failed to provide a new name for figures 1434–1435. Lamarck (1811), who should be regarded as the first reviser of the composite species *V. subdivisa*, restricted the Chemnitz figures 1434–1435 to the species *Vexillum subdivisum* (Gmelin), and for figures 1436–1437 he provided the new name *Mitra costellaris*. Lamarck (1822: 308) renamed the species *V. subdivisum* as *Mitra lyrata*, and this latter name becomes an objective synonym of *Vexillum subdivisum* (Gmelin).

1747 *V. caffrum*. Based on *Voluta caffra* Gmelin, sp. 51; Martini **4**, pl. 148, figs. 1369–1370 = ***Vexillum caffrum*** (L., 1758).

1748 *V. superbum*. Based on *Voluta plicaria* Gmelin, sp. 55; Martini, pl. 148, fig. 1365 = ***Vexillum vulpecula*** (L., 1758).

1749 *V. gloriosum*. Nomen nudum.*

1750 *V. laetum*. Nomen nudum.

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* This name was validated in 1819 in the second edition of the *Museum Boltenianum* where this species is figured on pl. 1.

SUMMARY OF NEW TAXA ESTABLISHED IN THE 'MUSEUM BOLTENIANUM'

GENERA

Pterygia Röding, 1798.
    Cylindra Schumacher, 1817, non Illiger, 1802.
    Cylindromitra P. H. Fischer, 1884.
Mitra Röding, 1798.
    Mitra Lamarck, '1799' [1798].
Vexillum Röding, 1798.
    Turricula Herrmannsen, 1849, non Schumacher, 1817.

SPECIES

Mitra imperalis Röding, 1798.
    Mitra pertusa auctt., non *Voluta pertusa* L., 1758.
    Mitra millepora Lamarck, 1811.
    Mitra digitalis '(Dillwyn)' auctt. = *Voluta digitalis* Link, 1807.
Pusia bernhardina (Röding, 1798).
    Pusia muriculata (Lamarck, 1811).
Mitra eremitarum Röding, 1798.
    Mitra adusta Lamarck, 1811.
Cancilla praestantissima (Röding, 1798).
    Mitra filosa auctt., non *Voluta filosa* Born, 1778.

Mitra perlata Röding, 1798 [= *Mitra chrysostoma* Broderip, 1836], is a nomen oblitum.

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REVISED LIST OF BRITISH MOLLUSCA
1. INTRODUCTION; NUCULACEA—OSTREACEA

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(*Read before the Society*, 13 *November* 1965)

INTRODUCTION

An up-to-date check-list of the British Mollusca, including both marine and non-marine species, has long been a desideratum. Much relevant taxonomic and nomenclatural revision has been accomplished in recent years, but the work is scattered among numerous publications and the need for a compilation of the results is evident. The present authors have found that a number of loose ends still remain to be tied owing to lack of agreement among specialists, insufficient evidence or, in some cases, to evidence being *sub judice* by the International Commission on Zoological Nomenclature. Consequently, it has been decided to submit a number of preliminary papers in which not only can fuller treatment of debatable points be given than in a mere check-list, but also in which the loose ends can be brought to the notice of those who may be able to assist in their tying.

The present list includes all species of Mollusca known to be native to, or living under natural conditions in, the British Isles. For the marine species, the scope is that of the British Marine Census Area (HEPPELL, 1964). A '**Q**' before a few of the names indicates that either their British or specific status is open to doubt.

The arrangement is systematic down to the family or subfamily level; below this the order of the species in each genus or subgenus and of the genera in each family or subfamily is alphabetical, except that the type-genus is always listed first. Infraspecific categories are omitted. The type-species of each genus is cited in its original binomen and, if that name is not currently valid, the original binomen of its valid synonym is cited also. A family name in square brackets indicates the original spelling of that name before emendation [ICZN Articles 11(e) (ii), 29]. A generic name in square brackets following a specific name indicates the original placement of that species. The expression '**O. L. Name No.** . . .' indicates that the family, genus or species concerned has been placed by the ICZN on the appropriate *Official List*. The symbol '§' indicates a subfamily or subgenus.

Numbers in parentheses, thus '(9)', refer to the explanatory notes at the end of each paper. In general, explanations have not been given where the present list does not differ from that of Winckworth (1932) for the marine species, or from that of Ellis (1951) for the non-marine species, or if the change is only one of order or of rank.

In placing these preliminary papers before the public, the authors hope that specialists will co-operate by informing them of any errors or omissions. Only in this way can accuracy be ensured before the publication of a definitive check-list.

Systematic List

PHYLUM MOLLUSCA
CLASS PELECYPODA (1)
SUBCLASS PROTOBRANCHIA
ORDER PALAEOTAXODONTA

NUCULACEA

Nuculidae Gray, 1824
Suppl. Append. Parry's Voy. NWest Passage 1819–20: ccxli.
Nucula Lamarck, 1799
Mém. Soc. Hist. nat. Paris (1) **1**: 87.
Type-species, by monotypy: *Arca nucleus* L., 1758.
N. hanleyi Winckworth, 1931 (2)
Proc. malac. Soc. Lond. **19**: 280.
N. nitidosa Winckworth, 1930 (3)
Proc. malac. Soc. Lond. **19**: 14.
N. nucleus (L., 1758) [*Arca*]
Systema Naturae, ed. 10 **1**: 695.
N. sulcata Bronn, 1831
Italiens Tertiär-Gebilde: 109. (4)
Nuculoma Cossmann, 1907
Bull. Soc. Agric. Hte-Saône (4) **7**: 124.
Type-species, by monotypy: *Nucula castor* Orbigny, 1850 (*Prodrome Paléont.* **1**: 339) [Jurassic fossil]. (5)
N. tenuis (Montagu, 1808) [*Arca*] (6)
Testacea Britannica **Supplement**: 56.

NUCULANACEA (7)

Nuculanidae Adams & Adams, 1858 (8)
Genera Rec. Moll. **2**: 660.

Nuculana Link, 1807
Beschr. Nat.-Sammlung Univ. Rostock (3): 155.
Type-species, by monotypy: *Arca rostrata* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3308) = *Arca pernula* Müller, 1779 (*Beschäft. Ges. naturf. Freunde Berl.* **4**: 57) [Arctic].
N. minuta (Müller, 1776) [*Arca*]
Zoologiae Danicae Prodromus: 247.

Portlandia Mørch, 1857
Fortegnelse over Grønlands Bløddyr: 21. In Rink, *Grønland geographisk og statistisk beskrevet* **2** (4).
Type-species [ICZN pending]: *Nucula arctica* Gray, 1824 (*Suppl. Append. Parry's Voy. NWest Passage 1819–20*: ccxli) [Arctic]. **(9)**

§ ***Yoldiella*** Verrill & Bush, 1897
Am. J. Sci. (4) **3**: 55.
Type-species, by original designation: *Yoldia lucida* Lovén, 1846.
P. lucida (Lovén, 1846) [*Yoldia*]
Index Moll. Scandinaviae: 34 [=*Öfvers. K. VetenskAkad. Förh.* **3** (6): 188].
P. philippiana (Nyst, 1844) [*Nucula*] **(10)**
Mém. cour. Mém. Sav. étr. Acad. r. Sci. Belg. **17**: 224.
Q ***P. pusilla*** (Jeffreys, 1879) [*Leda*] **(11)**
Proc. zool. Soc. Lond. **for 1879**: 580.

SUBCLASS PTERIOMORPHA
ORDER EUTAXODONTA

ARCACEA

Arcidae Lamarck, 1818 [Arcacées] **(12)**
Histoire nat. Anim. sans Vertèbres **5**: 423.

Arca L., 1758 [**O. L. Name No. 622**]
Systema Naturae, ed. 10 **1**: 645, 693.
Type-species, by designation under the plenary powers: *Arca noae* L., 1758 (*Systema Naturae*, ed. 10 **1**: 693) [ICZN Opinion 189] [Mediterranean].
A. tetragona Poli, 1795
Testacea utriusque Siciliae **2**: 137.

Arcopsis Koenen, 1885
Abh. K. Ges. Wiss. Göttingen **32** (Physikalische Classe) (1): 86.
Type-species, by selection by Reinhart, 1935 (*Bull. Mus. r. Hist. nat. Belg.* **11** (13): 30): *Arca limopsis* Koenen (tom. cit.: 85) [Oligocene fossil].

§ ***Galactella*** Cossmann, 1912 **(13)**
In Cossmann & Peyrot, *Conchologie Néogén. de l'Aquitaine* **2**: 192 [= *Act. Soc. linn. Bordeaux* **66**: 312].
Type-species, by original designation: *Arca lactea* L., 1758.
A. lactea (L., 1758) [*Arca*] **(14)**
Systema Naturae, ed. 10 **1**: 694.

Bathyarca Kobelt, 1891
In *Systematisches Conch.-Cab.*, ed. Küster (Lief. 390): 213.
Type-species, by selection by Verrill & Bush, 1898 (*Proc. U.S. nat. Mus.* **20**: 842): *Arca pectunculoides* Scacchi, 1834. **(15)**
B. pectunculoides (Scacchi, 1834) [*Arca*]
Annali civili del Regno delle Due Sicilie **6**: 82.

Glycymerididae Newton, 1916 [Glycymeridae] **(16)**
J. Conch. **15**: 81, 83.

Glycymeris da Costa, 1778
Historia nat. Test. Britanniae: 168.
Type-species, by tautonymy: *Arca glycymeris* L., 1758 [in synonymy of *Glycymeris orbicularis* da Costa, 1778 (loc. cit.)].
G. glycymeris (L., 1758) [*Arca*]
Systema Naturae, ed. 10 **1**: 695.

Limopsidae Dall, 1895
Trans. Wagner free Inst. Sci. Philad. **3** (3): 517.

Limopsis Sassi, 1827
Giornale ligustico di Scienze, Lettere, ed Arti **1**: 476.
Type-species, by monotypy: *Arca aurita* Brocchi, 1814.
L. aurita (Brocchi, 1814) [*Arca*]
Conchiologia foss. Subapennina **2**: 485.

ORDER ANISOMYARIA
SUBORDER ISOFILIBRANCHIA

MYTILACEA

Mytilidae Rafinesque, 1815 [Mytilidia]
Analyse de la Nature: 147.

§ **Mytilinae**

Mytilus L., 1758 [**O. L. Name No. 458**]
Systema Naturae, ed. 10 **1**: 645, 704.
Type-species, by selection by Anton, 1839 (*Verzeichniss Conchylien*: 17): *Mytilus edulis* L., 1758.
M. edulis L., 1758 [**O. L. Name No. 286**] **(17)**
Systema Naturae, ed. 10 **1**: 705.

§ **Crenellinae** Gray, 1840 [Crenellidae]
Synopsis Contents Brit. Mus., ed. 42: 151 **(18)**

Crenella Brown, 1827
Illustrations Conch. Great Britain & Ireland: pl. 31, figs. 12–14.
Type-species, by monotypy: *Crenella elliptica* Brown, 1827 (loc. cit.) = *Mytilus decussatus* Montagu, 1808.

§ ***Crenella*** s.s.
C. decussata (Montagu, 1808) [*Mytilus*]
Testacea Britannica **Supplement**: 69.

Q ***C. pellucida*** (Jeffreys, 1859) [*Limopsis*] **(19)**
Ann. Mag. nat. Hist. (3) **3**: 41.

§ ***Rhomboidella*** Monterosato, 1884
Nomenclatura gen. spec. Conch. mediterranee: 13.
Type-species, by monotypy: *Modiola rhombea* Berkeley, 1827 (*Zool. J.* **3** (10): 229) = *Modiola prideaux* Leach, 1815.

C. prideaux (Leach, 1815) [*Modiola*] **(20)**
Zoological Miscellany **2**: 35.

Idasola Iredale, 1915
Proc. malac. Soc. Lond. **11**: 340.
Proposed as nomen novum pro *Idas* Jeffreys, 1876 (*Ann. Mag. nat. Hist.* (4) **18**: 428) non Mulsant, 1875 [Aves].
Type-species, by monotypy: *Idas argenteus* Jeffreys, 1876 (loc. cit.) [North Atlantic].

I. simpsoni (Marshall, 1900) [*Myrina*] **(21)**
J. Malac. **7**: 167

Modiolarca Gray, 1842 [genus caelebs] **(22)**
Synopsis Contents Brit. Mus., ed. 44: 82.
Type-species, by subsequent monotypy (GRAY, 1843, in DIEFFENBACH, *Travels in New Zealand* **2**: 259): *Mytilus impactus* Hermann, 1782 (*Naturforscher, Halle* **17**: 152) [New Zealand].

M. tumida (Hanley, 1843) [*Modiola*] **(23)**
Illustrated Cat. Rec. bivalve Shells: 241.

Musculus Röding, 1798
Museum Boltenianum (2): 156.
Type-species, by selection by DALL, 1915 (*Nautilus* **28**: 138): *Mytilus discors* L., 1767 **(24)**

M. costulatus (Risso, 1826) [*Modiolus*]
Histoire nat. Europe méridionale **4**: 324.

M. discors (L., 1767) [*Mytilus*]
Systema Naturae, ed. 12 **1**: 1159.

M. niger (Gray, 1824) [*Modiola*] **(25)**
Suppl. Append. Parry's Voy. NWest Passage 1819–20: ccxliv.

§ **Modiolinae** Keen, 1958 [Modiolini]
Sea Shells of tropical West America: 54.

Modiolus Lamarck, 1799 [**O. L. Name No. 791**]
Mém. Soc. Hist. nat. Paris (1) **1**: 87.
Type-species, by absolute tautonymy: *Mytilus modiolus* L., 1758.

M. adriaticus (Lamarck, 1819) [*Modiola*]
Histoire nat. Anim. sans Vertèbres **6** (1): 112.

M. barbatus (L., 1758) [*Mytilus*]
Systema Naturae, ed. 10 **1**: 705.

M. gallicus (Dautzenberg, 1895) [*Modiola*]
Feuille jeun. Nat. **25**: 97.

M. modiolus (L., 1758) [*Mytilus*] [**O. L. Name No. 226**]
Systema Naturae, ed. 10 **1**: 706.

M. phaseolinus (Philippi, 1844)
Enumeratio Moll. Siciliae **2**: 51.

SUBORDER PTEROCONCHIDA

PTERIACEA (26)

Pteriidae Gray, 1847 [1828] [Pteriadae]
Proc. zool. Soc. Lond. (15): 199.

Pteria Scopoli, 1777
Introductio ad Hist. nat.: 397.
Type-species, by monotypy: *Mytilus hirundo* L., 1758.

P. hirundo (L., 1758) [*Mytilus*]
Systema Naturae, ed. 10 **1**: 706.

PINNACEA

Pinnidae Leach, 1819 (27)
J. Physique, Chimie, Hist. nat., Arts **88**: 466.

Atrina Gray, 1842 [genus caelebs]
Synopsis Contents Brit. Mus., ed. 44: 83.
Type-species, by selection by Gray, 1847 (*Proc. zool. Soc. Lond.* (15): 199): *Pinna nigra* Dillwyn, 1817 (*Descriptive Cat. Rec. Shells* **1**: 325) = *Pinna vexillum* Born, 1778 (*Index Rerum Naturalium Mus. Caes. Vindobonensis*: 118) [Indo-Pacific].

A. fragilis (Pennant, 1777) [*Pinna*]
British Zoology, ed. 4 **4**: 97 [4to ed.], 114 [8vo ed.].

PECTINACEA

Pectinidae Rafinesque, 1815 [Pectenia]
Analyse de la Nature: 148.
Pecten Müller, 1776 (28)
Zoologiae Danicae Prodromus: xxxi, 248.
Type-species, by selection by Children, 1823 (*Q. Jl Sci., Lond.* **15**: 40): *Ostrea maxima* L., 1758. (29)
P. maximus (L., 1758) [*Ostrea*]
Systema Naturae, ed. 10 **1**: 696.
Aequipecten P. H. Fischer, 1886
Manuel de Conchyliol.: 944.
Type-species, by monotypy: *Ostrea opercularis* L., 1758.
A. opercularis (L., 1758) [*Ostrea*]
Systema Naturae, ed. 10 **1**: 698.
Chlamys Röding, 1798
Museum Boltenianum (2): 161.
Type-species, by selection by Herrmannsen, 1847 (*Indicis Gen. Malac.* **1**: 231): *Ostrea islandica* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3326) [in synonymy of *Chlamys cinnabarina* Röding, 1798 (loc. cit.)] = *Pecten islandicus* Müller, 1776 (*Zoologiae Danicae Prodromus*: 248) [Arctic]. (30)
C. distorta (da Costa, 1778) [*Pecten*] (31)
Historia nat. Test. Britanniae: 148.
C. nivea (Macgillivray, 1825) [*Pecten*]
Edinb. phil. J. **13**: 166.
C. sulcata (Müller, 1776) [*Pecten*] (32)
Zoologiae Danicae Prodromus: 248.
C. varia (L., 1758) [*Ostrea*]
Systema Naturae, ed. 10 **1**: 698.
Cyclopecten Verrill, 1897 (31)
Trans. Conn. Acad. Arts Sci. **10**: 70.
Type-species, by selection by Sykes, Smith & Crick, 1898 (*Zool. Rec.* **34** (Mollusca): 75): *Pecten pustulosus* Verrill, 1873 (*Am. J. Sci.* (3) **5**: 14) [West Atlantic].
§ ***Delectopecten*** Stewart, 1930
Spec. Publs Acad. nat. Sci. Philad. **3**: 37, 118.
Type-species, by original designation: *Pecten vancouverensis* Whiteaves, 1893 (*Ottawa Nat.* **7**: 133) [North Pacific].
C. similis (Laskey, 1811) [*Pecten*] (33)
Mem. Werner. Soc. nat. Hist. **1**: 387.

Q ***C. vitreus*** (Gmelin, 1791) [*Ostrea*] **(34)**
Systema Naturae, ed. 13 **1**: 3328.

Palliolum Monterosato, 1884 **(31)**
Nomenclatura gen. spec. Conch. mediterranee: 5.
Type-species, by selection by CROSSE, 1885 (*J. Conchyliol.* **33**: 140): *Pecten incomparabilis* Risso, 1826 (*Histoire nat. Europe méridionale* **4**: 302) [Mediterranean].

P. furtivum (Lovén, 1846) [*Pecten*]
Index Moll. Scandinaviae: 31 [= *Öfvers. K. VetenskAkad. Förh.* **3** (6): 185].

P. striatum (Müller, 1776) [*Pecten*]
Zoologiae Danicae Prodromus: 248.

P. tigerinum (Müller, 1776) [*Pecten*] **(35)**
Zoologiae Danicae Prodromus: 248.

Pseudamussium Mørch, 1853 [**O. L. Name No. 1650**] **(31)**
Catalogus Conch. Yoldi **2**: 59.
Type-species, by designation under the plenary powers: *Pecten septemradiatus* Müller, 1776 [ICZN Opinion 714].

P. septemradiatum (Müller, 1776) [*Pecten*]
Zoologiae Danicae Prodromus: 248.

Limidae Rafinesque, 1815 [Limaridia]
Analyse de la Nature: 147.

Lima Bruguière, 1797
Tableau encyclop. méthodique: pl. 206 [nomen et figura].
Type-species, by subsequent tautonymy: *Ostrea lima* L., 1758 (*Systema Naturae*, ed. 10 **1**: 699) [in synonymy of *Lima alba* Cuvier, 1798 (*Tableau élém. Hist. nat. Anim.*: 421)] [Mediterranean and Atlantic].

§ ***Limaria*** Link, 1807
Beschr. Nat.-Sammlung Univ. Rostock (3): 157.
Type-species, by selection by WINCKWORTH, 1930 (*Proc. malac. Soc. Lond.* **19**: 116): *Limaria inflata* Link, 1807 [May] (loc. cit.) [= *Lima inflata* Lamarck, 1807 [January] (*Annls Mus. Hist. nat., Paris* **8**: 463) non *Ostrea inflata* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3321)], ? = *Ostrea tuberculata* Olivi, 1792 (*Zoologia Adriatica*: 120) [Mediterranean and Atlantic].

L. hians (Gmelin, 1791) [*Ostrea*] **(37)**
Systema Naturae, ed. 13 **1**: 3332.

§ ***Limea*** Bronn, 1831
Italiens Tertiär-Gebilde: 115. **(38)**
Type-species, by monotypy: *Ostrea strigilata* Brocchi, 1814 (*Conchiologia foss. Subapennina* **2**: 571) [Late Tertiary fossil].

L. loscombi G. B. Sowerby I, 1823 (39)
Genera Rec. foss. Shells (17): *Lima* fig. 4.

Limatula S. V. Wood, 1839
Mag. nat. Hist. (N.S.) **3**: 235.
Type-species, by selection by Gray, 1847 (*Proc. zool. Soc. Lond.* (15): 200): *Pecten subauriculata* [incorrectly cited by Gray as *subauricula*] Montagu, 1808.

L. gwyni (Sykes, 1903) [*Lima*] (40)
J. Malac. **10**: 104.

L. subauriculata (Montagu, 1808) [*Pecten*]
Testacea Britannica **Supplement**: 63.

Notolimea Iredale, 1924
Proc. Linn. Soc. N.S.W. **49**: 181, 194.
Type-species, by original designation: *Lima australis* E. A. Smith, 1891 (*Proc. zool. Soc. Lond.* **for 1891**: 444) [off New South Wales].

N. sarsii (Lovén, 1846) [*Limea*] (41)
Index Moll. Scandinaviae: 32 [= *Öfvers. K. VetenskAkad. Förh.* **3** (6): 186].

ANOMIACEA

Anomiidae Rafinesque, 1815 [Anominia]
Analyse de la Nature: 148.

Anomia L., 1758
Systema Naturae, ed. 10 **1**: 645, 700.
Type-species, by selection by Schmidt, 1818 (*Versuch Einricht. Conch.-Sammlungen*: 71, 177): *Anomia ephippium* L., 1758. (42)

A. ephippium L., 1758
Systema Naturae, ed. 10 **1**: 701.

Pododesmus Philippi, 1837
Arch. Naturgesch. **3** (1): 385.
Type-species, by monotypy: *Pododesmus decipiens* Philippi, 1837 (tom. cit.: 386) = *Placunanomia rudis* Broderip, 1834 (*Proc. zool. Soc. Lond.* (2): 2) [West Atlantic].

§ ***Heteranomia*** Winckworth, 1922 (43)
Proc. malac. Soc. Lond. **15**: 33.
Type-species, by monotypy: *Anomia squamula* L., 1758.

P. squamula (L., 1758) [*Anomia*]
Systema Naturae, ed. 10 **1**: 701.

§ ***Monia*** Gray, 1850
Proc. zool. Soc. Lond. (17): 121.
Type-species, by selection by Kobelt, 1881 (*Illustriertes Conchylienbuch*: 376): *Placunanomia zealandica* Quoy [sic], 1850 (tom. cit.: 123) =

Anomia zelandica Gray, 1843 (in Dieffenbach, *Travels in New Zealand* **2**: 260) [New Zealand].

P. patelliformis (L., 1761) [*Anomia*]
Fauna Suecica, ed. 2: 521.

P. squama (Gmelin, 1791) [*Anomia*]
Systema Naturae, ed. 13 **1**: 3346.

SUBORDER OSTREIFORMES

OSTREACEA

Ostreidae Rafinesque, 1815 [Ostreacia] [**O. L. Name No. 11**]
Analyse de la Nature: 148.

Ostrea L., 1758 [**O. L. Name No. 459**]
Systema Naturae, ed. 10 **1**: 645, 696.
Type-species, by Linnean tautonymy: *Ostrea edulis* L., 1758.

O. edulis L., 1758 [**O. L. Name No. 495**]
Systema Naturae, ed. 10 **1**: 699.

Crassostrea Sacco, 1897 [**O. L. Name No. 844**]
In Bellardi & Sacco, *Molluschi Terr. Terz. Piemonte e Liguria* **23**: 15.
Type-species, by original designation: *Ostrea virginica* [incorrectly cited by Sacco as *virginiana*] Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3336) [N. E. America].

C. angulata (Lamarck, 1819) [*Gryphaea*] [**O. L. Name No. 449**] (44)
Histoire nat. Anim. sans Vertèbres **6** (1): 198.

Pycnodonte G. Fischer, 1835
Byull. mosk. Obshch. Ispӯt. Prir. [= *Bull. Soc. imp. Nat. Moscou*] **8**: 118.
Type-species, by original designation: *Pycnodonte radiata* G. Fischer, 1835 (tom. cit.: 119) [Cretaceous fossil].

P. cochlear (Poli, 1795) [*Ostrea*] (45)
Testacea utriusque Siciliae **2**: 179.

EXPLANATORY NOTES

1. Critical reviews of previous attempts to classify the bivalves have been presented by Nicol (1954) and Cox (1960), from which it is clear that no completely satisfactory or generally acceptable classification has yet been proposed. The earlier systems were either based on a single morphological character—such as the form of the hinge-teeth, ligament, adductor scars or gills—or on a small number of such characters; but most modern workers are in agreement in using a compound arrangement, selecting taxobases from various systems at different levels of their classification.

Unfortunately this results in a non-uniformity of terminology but, as the megataxa of the competing systems are seldom exactly synonymous in their scope, this is largely unavoidable.

The classification adopted here for those groups treated in the present part is correlated, in Table 1, with that of WINCKWORTH (1932), THIELE (1934), COX (1960), KEEN (1963) and MORTON & YONGE (1964). As there is at present no official ruling for standardization of termination for taxa above the family-group, the present authors have preferred to maintain the original spellings of all higher taxa used herein.

Of the three terms Bivalvia, Lamellibranchia and Pelecypoda the last is employed because of its conformity with the class names Gastropoda, Scaphopoda and Cephalopoda, and because it appears to be the form most in vogue at this time. The use of the term Lamellibranchia at the class level might lead to some ambiguity in view of its recent demotion by MORTON & YONGE (see Table 1). Almost all modern workers agree that the Protobranchia are worthy of separation at the subclass level and that the association with them of the Arcacea, because of the superficial resemblance of their dentition, is artificial. We have followed COX and KEEN in regarding the Arcacea as forming an order of the subclass Pteriomorpha but have retained the more familiar term Anisomyaria to cover the remaining superfamilies of the subclass, rather than extend the scope of COX's innovation Pteroconchida, as KEEN has done. COX's divisions have, however, been retained at the suborder level, although IREDALE's term Ostreiformes has been preferred to COX's Colloconchida as it is more descriptive and more familiar to the British worker.

2. Although recognized as a good species by ALLEN (1954), a number of recent authors (e.g. SORGENFREI, 1958) consider *N. hanleyi* to be merely a variety of *N. nucleus*.

3. This species was long known as *N. nitida* G. B. Sowerby II, 1833 (*Conchological Illustr.* (16): fig. 20). WINCKWORTH (1930a) pointed out that this name was preoccupied by *Arca nitida* Brocchi, 1814 (*Conchiologia foss. Subapennina* **2**: 482) and proposed the new name *N. nitidosa*. In a later paper (WINCKWORTH, 1931) he concluded, from the researches of MOORE (1931), that his *N. nitidosa* included two distinct forms and proposed that, as he had previously overlooked the earlier name *N. nitida* var. *turgida* Leckenby & Marshall, 1875 (*Ann. Mag. nat. Hist.* (4) **16**: 391), they should be known as *N. turgida* Leckenby & Marshall and *N. moorei* Winckworth. After re-examining the specific characters of a large number of specimens of *N. turgida* and *N. moorei*, however, ALLEN (1953) found that no clear distinction could be made between the two, and suggested that *N. moorei* should be considered a synonym of *N. turgida*. *N. turgida* Leckenby & Marshall, however, is a junior homonym of *N. turgida* Gould, 1846 (*Proc. Boston Soc. nat. Hist.* **2**: 100), a Burmese shell, and it appears that the name *N. nitidosa* Winckworth must be revived for the British species.

4. Pages 509–646 of volume 2 of BRONN's *Ergebnisse naturhist. Reisen* form a distinct section entitled 'Uebersicht der fossilen Ueberreste in den tertiären subapenninischen Gebirgen' which was also issued as a separate both under that title and also as the *Italiens Tertiär-Gebilde*. According to a manuscript note by C. D. SHERBORN on p. 509 of volume 2 of the copy of BRONN's *Ergebnisse* in the library of the British Museum (Natural History) the 'Uebersicht der fossilen Ueberreste' was published just previously in 1831 in the *Italiens Tertiär-Gebilde*, pp. 1–138. In the *Ergebnisse*, *N. sulcata* occurs on p. 617.

5. ORBIGNY (loc. cit.) cites '*Nucula castor* Orbigny, 1847', but this must refer to a manuscript usage of the name. Some copies of the *Prodrome Paléont.* have the title-page of volume 1 dated 1849, others are dated 1850. According to SHERBORN (1922: xcviii) it was published in January, 1850.

Table 1

Correlation of some recent systems of bivalve classification

Thiele, 1934	Winckworth, 1932*	Morton & Yonge, 1964
c. BIVALVIA	c. LAMELLIBRANCHIA	c. BIVALVIA
	sc. PRIONODESMACEA	sc. PROTOBRANCHIA
o. TAXODONTA	o. PROTOBRANCHIA	
NUCULACEA	NUCULACEA	NUCULACEA
		sc. LAMELLIBRANCHIA
	o. FILIBRANCHIA	o. TAXODONTA
ARCACEA	ARCACEA	ARCACEA
o. ANISOMYARIA		o. ANISOMYARIA
MYTILACEA	MYTILACEA	MYTILACEA
ANOMIACEA	ANOMIACEA	ANOMIACEA
	o. PSEUDOLAMELLIBRANCHIA	
PTERIACEA	PTERIACEA	PTERIACEA
PECTINACEA	PECTINACEA	PECTINACEA
OSTREACEA	OSTREACEA	OSTREACEA

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* Winckworth, 1932, did not employ the category 'superfamily'. To permit uniformity of presentation in this table his families have been placed in the appropriate 'stirps' of Thiele, 1934.

Table I (*continued*)

Keen, 1963	Cox, 1960	Bowden & Heppell
c. PELECYPODA	c. BIVALVIA	c. PELECYPODA
sc. PRIONODESMATA	sc. PROTOBRANCHIA	sc. PROTOBRANCHIA
o. PROTOBRANCHIA	o. PALAEOTAXODONTIDA	o. PALAEOTAXODONTA
so. PALEOTAXODONTIDA		
NUCULACEA	NUCULACEA	NUCULACEA
		NUCULANACEA
sc. PTERIOMORPHIA	sc. PTERIOMORPHIA	sc. PTERIOMORPHA
o. PRIONODONTIDA	o. EUTAXODONTIDA	o. EUTAXODONTA
ARCACEA	ARCACEA	ARCACEA
o. PTEROCONCHIDA	o. ISOFILIBRANCHIDA	o. ANISOMYARIA
		so. ISOFILIBRANCHIA
MYTILACEA	MYTILACEA	MYTILACEA
	o. PTEROCONCHIDA	so. PTEROCONCHIDA
ANOMIACEA	ANOMIACEA	ANOMIACEA
PTERIACEA	PTERIACEA	PTERIACEA
PINNACEA	PINNACEA	PINNACEA
PECTINACEA	PECTINACEA	PECTINACEA
	LIMACEA	
	o. COLLOCONCHIDA	so. OSTREIFORMES
OSTREACEA	OSTREACEA	OSTREACEA

6. Van der Poel (1955) has proposed the division of the family Nuculidae—with the exception of the *Acila* group—into two genera *Nucula* and *Nuculoma* on the basis of the shell structure. Other nuculid taxa are retained as subgenera. Species in which the outer shell layer is built up of radial elements are included in *Nucula*; those with a uniform non-radial shell structure are referred to *Nuculoma*. The work of Sorgenfrei (1937; 1958) confirms the fundamental nature of this difference in shell structure and suggests that van der Poel's division of the family is both practical and sound.

7. McAlester (1964), from a study of Early Palaeozoic nuculoid bivalves and from consideration of anatomical work on Recent species, concluded that there is a primary evolutionary branching into two distinct groups—represented by nuculid and nuculanid forms—and that each of these groups merits the rank of superfamily.

8. Ledidae Adams & Adams, 1858 (*Genera Rec. Moll.* **2**: 546 [January]) has ten months' priority over Nuculanidae Adams & Adams, 1858 (tom. cit.: 660 [November]), but as the name of this family has become generally accepted as Nuculanidae the latter name may be retained under the terms of ICZN Article 40(a).

9. Because of the considerable amount of confusion which has been associated with the type-species of *Yoldia* Möller, 1842, and *Portlandia* Mørch, 1857, Soot-Ryen (1964) applied to the ICZN for a ruling that all previous designations of type-species for these two genera be set aside and that, under the plenary powers, the type-species be designated as *Yoldia hyperborea* Torrell, 1859, and *Nucula arctica* Gray, 1824, respectively. We have followed current practice in regarding *Yoldiella* as a subgenus of *Portlandia*.

10. This species was described by Jeffreys (1864: 154)* as '*Leda pygmaea* Münster'. Recognizing that this was not *Nucula pygmaea* Münster, 1837 (in Goldfuss, *Petrefacta Germaniae* **2**: 157),† Winckworth (1932: 239, 251) proposed the new name *Yoldiella tomlini* 'for the shell described by Jeffreys in *British Conchology* as *Leda pygmaea*'. After examining photographs of the figured specimen in the Jeffreys Collection in the U.S. National Museum (kindly provided by Dr H. A. Rehder), Dr T. Soot-Ryen and cand. phil. K. W. Ockelmann informed us (*in litt.*) that this is conspecific with *Nucula tenuis* Philippi, 1836 (*Enumeratio Moll. Siciliae* **1**: 65). As the latter name is a junior secondary homonym of *Arca tenuis* Montagu, 1808—a fact which Philippi himself later recognized (op. cit. **2**: 46)—it must be rejected under ICZN Article 59(c).‡ The next available name —pointed out to us by Dr Soot-Ryen—is *Nucula philippiana* Nyst, 1844.

Dall (in Odhner, 1915: 68) recorded '*Portlandia fraterna* (Verrill & Bush)' from the Minch on the basis of some shells obtained by the 'Porcupine' Expedition and now in the Jeffreys Collection. Ockelmann (1959: 39)§ considered that these specimens are probably referable to *P. inconspicua* (Verrill & Bush, 1898). There seems to be no evidence that the record is based on other than dead shells. The specimens are not recorded in the reports of the 'Porcupine' Expedition, and there was no dredging station in the Minch on any of its cruises.

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* Dated 1863 on title-page, but published in 1864 *fide* Martens, 1866 (*Zool. Rec.* **2**: 232).

† *Nucula pygmaea* Münster, 1835 (*Neues Jb. Miner. Geogn. Geol. Petrefaktenk.* **3**: 448) is a nomen nudum.

‡ We are informed by the ICZN (*in litt.*) that a secondary homonym rejected before 1960 is rejected for ever—i.e. it is the converse of Article 59(c) not of Article 59(b) that holds true.

§ Dated 1958 on title-page, but reprint dated January 1959 on p. 256. Ockelmann himself cites this work as '1959' in subsequent papers.

11. WINCKWORTH (1932: 239) included '*Phaseolus pusillus* (Jeffreys, 1879)', but there appears to be no evidence that this species has ever been found living within the limits of the British Marine Census Area. CHASTER's records (1897; 1898) refer explicitly to dead shells only, but as his material included 'a perfect though dead specimen' from off Ballycastle, Co. Antrim (1897: 124), the species is retained here with a query.

Examination of the type-specimens of *Leda pusilla* in the collection of the British Museum (Natural History) confirms what is evident from JEFFREYS's original figure of the species—that the hinge-teeth are quite unlike the oblique, lamellar teeth characteristic of the genus *Phaseolus*. The species is here tentatively included in *Yoldiella*. Those authors (e.g. DELL, 1956: 127)* who have dated *Phaseolus* from SEGUENZA, 1877 (*Atti R. Accad. Lincei* (3) *Memorie* (Sci. fis. mat. e nat.) **1**: 1182), and considered *Phaseolus* Monterosato, 1875 (*Atti Accad. Sci. Lett., Palermo* (N.S.) **5**: 4, 11), to be a nomen nudum, have overlooked MONTEROSATO's brief description of the genus on p. 4.

12. According to ICZN Article 11(e) (iii): 'A family-group name published before 1900 in accordance with the above provisions of this Section, but not itself fully latinized, is available with its original date and authorship, provided that it has been latinized by later authors and that it has been generally accepted by zoologists interested in the group concerned as dating from its first publication in vernacular form'. As LAMARCK's family-group name 'Arcacées' satisfies all the criteria of availability, it must be considered available (after emendation to 'Arcidae' [Articles 11(e) (ii), 29]) as of its use in the 'Division des Conchifères', although the family is not described until 1819 (*Histoire nat. Anim. sans Vertèbres* **6** (1): 32). Family-group names are used by LAMARCK in 1809 in his *Philosophie Zoologique*, but that work is wholly vernacular and any names contained in it must be regarded as unavailable for the purposes of nomenclature [Article 11(c)].

13. COSSMANN & PEYROT (loc. cit.) cite '*Galactella* Cossmann 1911', but this must refer to a manuscript usage of the name. In the 'Supplément aux "Pélécypodes"' the reference to *Fossularca* (*Galactella*) *miocaenica*, described in the body of the work, is cited as 'Cossm. et Peyr., 1913', but this seems to be an error as, according to PRESTON, 1914 (*Zool. Rec.* **49** (8): 9), pp. 121–324 [= pp. 1–204 of separate] were published in 1912.

14. WINCKWORTH (1932: 239) included this species in *Barbatia*. In a later paper (1934a) he agreed with critics that it was a *Fossularca*, which group he had previously considered to be merely a 'section' of *Barbatia*, but he refrained from using the name *Fossularca* 'as there are two earlier synonyms, namely *Arcopsis* von Koenen 1884 and *Trigonodesma* S. V. Wood 1864'. Accordingly, he placed *A. lactea* in the subgenus *Trigonodesma*. REINHART (1935), however, while admitting a resemblance to *Arcopsis* in the position of the ligament, regarded *Trigonodesma* as being 'on the border line of the families Arcidae and Limopsidae' and, 'because of its trigonal form and generally opisthogyrous beaks', placed it in the subfamily Noetiinae.

In synonymizing *Fossularca* with *Arcopsis* WINCKWORTH was almost certainly correct: the latter name was overlooked for many years, but since VINCENT (1930: 71) demonstrated its priority over *Fossularca* it has become generally accepted that the two names are synonymous. STEPHENSON (1923: 109) suggested that *Fossularca* was probably a synonym of *Striarca* Conrad, 1862, but later authors have tended to keep the two genera (*Striarca* and *Arcopsis*) apart.†

Galactella Cossmann & Peyrot, of which *Arca lactea* is the type-species, was proposed as a subgenus of *Fossularca*. REINHART (1935), however, regarded it as a synonym of *Striarca* because of 'a striking similarity' between *A. lactea* and the type-species of *Striarca*. *A. lactea* does not have the dentition interrupted in the centre by a gap, as in typical *Arcopsis*, but does have the ligament limited to a small area between the umbones: in view of this, the present authors prefer provisionally to retain *Galactella* as a subgenus of *Arcopsis*.

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* Reprint dated November 1955, but published 1956 *fide* SALISBURY, 1957 (*Zool. Rec.* **92** (9): 11).

† In *Striarca* the entire cardinal area is covered by the ligament, whereas in *Arcopsis* the lozenge occupied by the ligament is small and leaves a large part of the cardinal area uncovered on both sides of the umbo. *Arcopsis* also exhibits a characteristic sculpture.

15. *Arca pectunculoides* is occasionally cited as the type-species of *Bathyarca* 'by original designation', but no such designation was evident to us on inspection of KÜSTER's work. The earliest subsequent designation appears to be that of VERRILL & BUSH.

16. The oldest available name for this family-group is, apparently, Axinaeinae Adams & Adams, 1858. VOKES & COX (1961), however, in an application to the ICZN, have requested the suppression of this name under the plenary powers for the purposes of the Law of Priority but not for those of the Law of Homonymy, in order to make available the name Glycymeridae in its accustomed sense. Pectunculidae, although prior, is invalid, as its type-genus *Pectunculus* Lamarck, 1799, is a junior homonym of *Pectunculus* da Costa, 1778 [ICZN Article 39]. The applicants overlooked the fact that Glycymeridae Herrmannsen, 1847 (*Indicis Gen. Malac.* **1**: 482) [an incorrect spelling for Glycimeridae Deshayes, 1839 (*Traité élém. Conchyliol.* **1** (2): 124) [Glycimérides] [based on *Glycimeris* Lamarck, 1801 [= *Cyrtodaria* Reuss, 1801] non *Glycimeris* Lamarck, 1799 [=*Panopea* Ménard de la Groye, 1807]]], must also be suppressed.* Also, the present authors have discovered earlier uses of the names Glycymeridae and Pectunculidae than those submitted by VOKES & COX for addition to the appropriate *Official List* and *Official Index* respectively. Pectunculidae was published by GRAY *ex* LEACH MS., 1847 (*Ann. Mag. nat. Hist.* (1) **20**: 273), which is fifty-one years prior to DALL's usage cited by the applicants, while Glycymeridae occurs in a paper by NEWTON, 1916 (*J. Conch.* **15**: 81, 83), fourteen years before STEWART's use of the name. ROBERTSON (1962) has drawn attention to a paper by STENZEL *et al.* (1957) in which it is shown (pp. 59–60) that this family name should be spelt Glycymerididae, not Glycymeridae. As the decisions of the ICZN in this case have not yet been published, the family name Glycymerididae Newton, 1916, is used herein.

17. In addition to *M. edulis*, WINCKWORTH (1932: 240) listed the Mediterranean *M. galloprovincialis* Lamarck, 1819. This species is stated by HEPPER (1957) to be abundant on the coasts of Devon, Cornwall and South Wales. Consideration of the literature and examination of specimens obtained from the Mediterranean, however, led LEWIS & POWELL (1961) 'to the taxonomic conclusion of several other recent workers that *M. galloprovincialis* Lmk. cannot be separated (on present evidence) as more than a race or subspecies of *M. edulis* L. In certain circumstances it appears to be impossible to distinguish between the two entities.'

18. IREDALE (1913) has shown that there were two printings of the forty-second edition of the *Synopsis Contents Brit. Mus.*, the earlier dated 'October 16, 1840' and the later dated 'Nov. 4, 1840'. In the later printing Crenellidae appears on p. 155.

19. The systematic position of this species is uncertain and, as the present authors have been unable to examine specimens, they can offer no opinion. It is figured by JEFFREYS (1859: pl. 2, figs. 6 a–d), G. B. SOWERBY III (1887: pl. 8, fig. 14—as the 'fry' of *Crenella rhombea* (Berkeley) [= *C. prideaux*

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* Although HERRMANNSEN, 1847 (loc. cit.) attributed the name 'Glycymeridae' to DESHAYES, 1839, only the vernacular 'Les Glycimérides' occurs in the latter work. The earliest correct latinization of this name [i.e. Glycimeridae] that we have discovered is by CHENU, 1862 (*Manuel Conchyliol.* **2**: 25), who attributed the name to DESHAYES, 1839. The name is available with its original date and authorship under the terms of Article 11(e) (iii), but even so is a junior synonym of Hiatellidae Gray, 1824 [Hyatelladae].

(Leach)]) and by CHASTER (1895: fig. 3). The suggestion that it was the 'fry' of *C. rhombea* originated from JEFFREYS (1864: 132), but a comparison with the 'fry' of that species by CHASTER (1895: 59) showed this to be incorrect. As a British species it appears to have been recorded only from Guernsey (JEFFREYS, 1859: 41; CHASTER, 1895: 58), but single valves in abundance were recorded by MONTEROSATO (1875: 7) from Palermo in mud at 30–90 metres depth.

20. According to Article 31 of the 1961 edition of the ICZN, 'a species-group name, if a noun formed from a modern personal name, must end in *-i* if the personal name is that of a man . . .', and, under Article 31(a), such a species-group name, if treated as a noun in apposition to the generic name, was to be corrected by adding the appropriate genitive termination. In the 1964 edition of the ICZN, however, Article 31 was reduced to a non-retroactive recommendation and Article 31(a) was deleted. Thus, as the Code stands at present, LEACH's original use of this specific name as a noun in apposition to the generic name must be regarded as correct, and '*prideaux*' re-instated vice '*prideauxi*'.

21. Two mytilid genera are known to be associated with whale remains, such as floating blubber or dredged skulls. These are *Adipicola* Dautzenberg, 1927 [= *Myrina* Adams & Adams, 1854, non Fabricius, 1807], and *Idasola* Iredale, 1915 [= *Idas* Jeffreys, 1876, non Mulsant, 1875]. *Adipicola* appears to be most closely related to *Modiolus*, while *Idasola* belongs to the *Musculus-Crenella* group of genera. Judging from the characters of the hinge, *Myrina simpsoni* Marshall appears to us not to be an *Adipicola* but an *Idasola.*

22. SOOT-RYEN (1955: 73–74) pointed out that, while resembling *Musculus* in general form and sculpture, this species—along with *Musculus impactus* (Hermann), *M. cumingianus* (Reeve) and *M. lebourae* White—is quite different anatomically and must be placed in a separate genus, the best name for which he considered to be *Lanistina* Gray, 1847. FLEMING (1959) criticized SOOT-RYEN's use of *Lanistina* and proposed instead the new genus *Ryenella* with *Mytilus impactus* Hermann, 1782, as type-species. In discussing the correct name for this genus the following have to be considered: *Modiolaria, Modiolarca, Lanistes, Lanistina, Ryenella.*

Modiolaria is commonly attributed to BECK, 1838 (in GAIMARD, *Voyage en Islande et au Groenland* **Atlas zool.**: Mollusques, pl. 17), but this atlas does not appear to have been published until 1851,* by which time the name had been validated by LOVÉN, 1846 (*Index Moll. Scandinaviae*: 33 [= *Öfvers. K. VetenskAkad. Förh.* **3** (6): 187]). References to the name in BECK's *Index Moll. Mus. Christiani Frederici* are to a manuscript usage, as only the pulmonate part of that work was published. LOVÉN included the species *M. discors*, *M. laevigata*, *M. nigra* and *M. marmorata*, and of these *M. discors* was selected as type-species by STOLICZKA, 1871 (*Mem. Geol. Surv. India, Palaeontologia Indica* (6) **3**: 368). *Modiolaria* Lovén, 1846 (*ex* Beck MS.) [non Gray, 1847 = *Gaimardia* Gould, 1852], is thus an absolute synonym of *Musculus* Röding.

Lanistes Swainson, 1840 (*Treatise Malac.*: 385) contains only '*discors. En. Méth.* 204. f.5.'. This figure was regarded by SOOT-RYEN (1955: 74) as representing not *Mytilus discors* L. but *M. impactus* Hermann and, accordingly, he considered *M. impactus* to be the type-species of *Lanistina* Gray, which is a nomen novum pro *Lanistes* Swainson, 1840, non Montfort, 1810. FLEMING (1959: 173), however, reasoned that, as there is no evidence that SWAINSON intended to cite a different taxon from *M. discors* L. under *Lanistes*, his reference to a figure of another species should not affect the issue. He concluded that, as SWAINSON, in proposing *Lanistes*, did not clearly indicate that he applied the name *discors* to any species other than that to which it was applied by its original (in this case unnamed) author, the type-species of *Lanistes* Swainson—and hence of *Lanistina* Gray—must be *Mytilus discors* L., making these two names also absolute synonyms of *Musculus* Röding. For the *impactus* group FLEMING proposed the new name *Ryenella*.

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* No date appears on the title-page of this atlas, and in a paper on the dates of publication of the natural history parts of this work (SHERBORN & WOODWARD, 1901: 334) only the text is considered. In the *Index Animalium*, SHERBORN cites 1838 as the date of *Modiolaria* and of the specific names *discors*, *faba*, *laevis* and *striatula* in combination with that generic name, whereas other 'new' names occurring in this atlas are attributed by him either to other works published between 1838 and 1851 or, if attributed to the atlas, they are dated 1851. SCHULZE *et al.* (1932: 2122) give the date of *Modiolaria* as 1851, which is the date given for the publication of this atlas by WOODWARD (1904: 607).

SOOT-RYEN (loc. cit.) considered using the name *Modiolarca*—which has five years' priority over *Lanistina*—for the *impactus* group, but dismissed it as being possibly a misprint for *Modiolaria*—a suggestion which had been made previously by IREDALE (1913: 306). In a later paper, however, IREDALE (1914) withdrew this opinion, and summarized the status of *Modiolarca* as follows: 'This genus-name first appears in the *Synopsis of the Contents of the British Museum*, 42nd ed., p. 151, 1840, where, associated with *Crenella*, the two genera constitute the family Crenellidae. I have shown in my Collation of these synopses [IREDALE, 1913] that here the genus-names are all absolutely *nomina nuda*. On p. 306 I noted that in the forty-fourth edition short diagnostic remarks were added, and quoted those referring to this name, which read "(p. 82) The *Crenellæ* are suborbicular and the *Modiolariæ* ovate elongated shells", and added a "Note: *Modiolarca*, 1840, is thus a misprint for *Modiolaria*". Further investigation shows this conclusion to have been incorrect . . .' IREDALE then cited the use of *Modiolarca* Gray, 1843 (in DIEFFENBACH, *Travels in New Zealand* **2**: 259), and continued: 'This is the first recognizable introduction of the genus-name *Modiolarca*, and as it is associated with *impacta* it must fall as a synonym of the earlier *Modiolaria*'. As *Mytilus impactus* and *M. discors* are no longer considered congeneric, however, the name *Modiolarca* becomes available again and must be removed from the synonymy of *Musculus* and *Modiolaria*. Although it is debatable whether or not *Modiolarca* is a nomen nudum in 1842, it is here regarded as a genus caelebs with type-species *Mytilus impactus* determined by subsequent monotypy in 1843 [cf. GRAY's proposal of *Atrina* in similar circumstances]. *Ryenella* Fleming, 1959, is thus an absolute synonym of *Modiolarca* Gray, 1842.

23. *Mytilus marmoratus* Forbes, 1838 (*Malacologia Monensis*: 44), is a junior primary homonym of *Mytilus marmoratus* Schroeter, 1803 (*Arch. Zool. Zoot.* **3** (2): 50). An earlier name for this species may be *Modiolus subpictus* Cantraine, 1835 (*Bull. Acad. r. Sci. Brux.* **2**: 397), from the Gulf of Venice, but this name is considered here to be a nomen dubium. The next available name appears to be *Modiola tumida* Hanley, 1843, which was proposed as a new name for *M. discors* of DA COSTA, MONTAGU, and other British authors, but not of LINNAEUS.

24. At least three type-designations for *Musculus* Röding were published in 1915—one by DALL (*Nautilus* **28**: 138), and two by IREDALE (*J. Conch.* **14**: 32; *Trans. Proc. N.Z. Inst.* **47**: 485): DALL's paper is dated April, whereas IREDALE's two papers were both published in the July. Fortunately, all three designations are of the same species.

25. SHERBORN (1928: 4316) listed this name as a nomen nudum, but although GRAY offers no description he gives as synonyms '*Modiola discrepans*. Leach. *Ross's Voyage*, not of Lamarck. *Mytilus discrepans*. Mont[agu]. *Brit. Shells*, t.26. f.4.' It is thereby evident that *Modiola nigra* was proposed as a nomen novum pro *M. discrepans* auctt. non Lamarck, 1819, and that it satisfies the criteria of availability for a name of the species-group [ICZN Articles 11, 12, 16(a) (i)]. [*M. discrepans* Lamarck, 1819, non Montagu, 1803 = *M. marmoratus* Forbes, 1838, non Schroeter, 1803; *M. discrepans* Montagu, 1803 = *M. discors* L., 1767].

26. A family-group taxon formed by the union of two or more taxa of that group takes the oldest valid family-group name among those of its components, with change of termination if required

[ICZN Article 23(d) (i)]. Determination of the correct name for this superfamily involves, therefore, a discussion of the correct names of its included families.*

The consensus of current opinion classifies the relevant genera into three families containing respectively (i) *Crenatula*, *Isognomon* and *Melina*, (ii) *Vulsella* and *Malleus*, and (iii) *Pteria* and *Pinctada*. Those authors who recognize additional generic taxa fit them into one or other of the above family-groups, the first two groups being sometimes regarded as a single family.

In the first group the earliest family name is Pernidae Rafinesque, 1815 [Pernaridea] (*Analyse de la Nature*: 147). This name is invalid [Article 39] as its type-genus *Perna* Bruguière, 1789 (*Encyclopédie méthodique* **1**: xiii) is a junior homonym of the mytilid *Perna* Philipsson, 1788. The next available name in this group appears to be Isognomonidae Woodring, 1925 (*Publs Carnegie Instn* **366**: 57), which name is now in general use.

The earliest available name within the second group is Malleidae Lamarck, 1818 [Malléacées] (*Histoire nat. Anim. sans Vertèbres* **5**: 424) [see discussion of LAMARCK's vernacular family names under note **12** above]. This was first correctly latinized [as Malleacea] by BRONN, 1824 (*System urwelt. Konchyl.*: 31) and [as Malleidae] by BRODERIP, 1839 (*Penny Cyclopaedia* **14**: 319, 334).† This family name, based on *Malleus* and attributed to LAMARCK, was in general use during the nineteenth century, but more recently has been abandoned in favour of the name Vulsellidae, which dates from ADAMS & ADAMS, 1857 (*Genera Rec. Moll.* **2**: 523). This change was probably made on account of the growing acceptance of RÖDING's names—*Vulsella* Röding, 1798, being one year earlier than (though, of course, not synonymous with) *Malleus* Lamarck, 1799. Although there has never been an official ruling that a family name should be based on the oldest included generic name, family names, nevertheless, have occasionally become established on that basis. The present ruling [Article 23(d) (i), cited above] is that the relative priority depends on the dates of the family names themselves, but [Article 23(d) (ii)] 'if a zoologist observes that the strict application of the Law of Priority to two or more synonymous family-group names would upset general usage, he is to request the Commission to decide which name is to be accepted for the Official List of Family-Group Names in Zoology'. As the names Malleidae and Malleacea have now fallen into disuse, it is here considered undesirable to resurrect them. Vulsellidae Adams & Adams, 1857, should stand as the valid name for this family and application be made for its addition to the *Official List*.

For the third group the oldest name appears to be Margaritidae Blainville, 1818 [Margaritacea] (*Dictionnaire des Sciences naturelles* **10**: 216) based on *Margarita* Leach, 1814 (*Zoological Miscellany* **1**: 107), a junior subjective synonym of *Pinctada* Röding, 1798. This name achieved little currency and is now never used. The next available name is Aviculidae, but the authorship and date of that name is open to some doubt. GOLDFUSS, 1820 (*Handbuch Zool.* **1**: 607) used 'Aviculae' (*fide* HERRMANNSEN, 1852 (*Indicis Gen. Malac.* **Supplement**: 15)); the present authors have not seen this work of GOLDFUSS and cannot be sure, therefore, whether the name is clearly used to denote a suprageneric taxon or merely as a plural noun referring to the members of a genus [Article 11(e) (i)]. If this usage should prove to be invalid, it might be possible, under the terms of Article 11 (e) (iii), to date the name from FÉRUSSAC, 1822 (*Tableaux systém. Anim. mollusques*: xxxix), where the vernacular 'Aviculés' occurs, but we have not discovered a single subsequent author who attributes this family name to FÉRUSSAC. The first indisputable use of the name is by MENKE, 1828 (*Synopsis method. Moll.*: 60) [Aviculaceae]. As the type-genus of Aviculidae—*Avicula* Bruguière, 1792

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* The genera comprising the family Pinnidae are here referred to a distinct superfamily Pinnacea, but it should be noted that the name Pinnidae is earlier in date than any of the recognized family names in the group under consideration and that if these two superfamilies were reunited the name Pinnacea would have to be adopted for the aggregate on grounds of priority.

† The 'Malleacea Féruss[ac], 1821' cited by HERRMANNSEN, 1847 (*Indicis Gen. Malac.* **2**: 14) as of p. xli of the *Tableaux systém. Anim. mollusques* occurs there only as the vernacular 'Malléacés': the correct date for that page is 1822, *fide* KENNARD, 1942 (*Proc. malac. Soc. Lond.* **25**: 106).

(*Tableau encyclop. méthod.*: pl. 177)—is a junior objective synonym of *Pteria* Scopoli, 1777, and as the family name Pteriidae has won general acceptance, the latter name is to be maintained in the interests of stability [Article 40(a)], and takes the date of the rejected name of which it is to be considered the senior synonym [Article 40(b)]. Pteriidae, accordingly, takes priority as of the date of the rejected Aviculidae which, for the reasons presented above, is here dated from MENKE's usage of Aviculaceae in 1828. The earlier name Margaritidae is rejected under the terms of Article 23(d) (ii) as it is assumed this would be the inevitable decision of the ICZN if the case were brought to their notice.

According to ICZN Recommendation 40A, if author and date are cited, a family-group name adopted under the provisions of Article 40 should be cited with its own author and date, followed by the date of the replaced name in parentheses. It follows that it is still necessary to determine the authorship and date of Pteriidae. HERRMANNSEN, 1847 (*Indicis Gen. Malac.* **2**: 343) cites 'Pteridae Broderip, 1839. *Penny Cyclop.* XIV' on the authority of AGASSIZ's *Nomenclator*, but a search of volume 14 of the *Penny Cyclopaedia* failed to confirm this citation, BRODERIP having used Malleidae in the articles on 'Malacology' (pp. 314–325) and on 'Malleacea, or Malleidae' (pp. 334–337). The first use of Pteriidae appears to be that of GRAY, 1847 (*Proc. zool. Soc. Lond.* (15): 199) [Pteriadae].

We conclude that the names to be used for the three families considered here are (i) Isognomonidae Woodring, 1925, (ii) Vulsellidae Adams & Adams, 1857, and (iii) Pteriidae Gray, 1847 [1828]. Of these the earliest is Pteriidae, and this must be used as the basis of the superfamily name.

27. Although Pinnidae Leach, 1819, contained only the genera *Modiola* and *Mytilus* this would not seem to preclude its use for *Pinna* and allied genera on which the family name is obviously based.

28. *Pecten* Müller, 1776, is preoccupied by *Pecten* Osbeck, 1765 (*Reise nach Ostindien und China*: 391), the type-species of which, by monotypy, is *Pecten adscensionis* Osbeck, 1765.* WINCKWORTH (1934b) discussed the validity of *Pecten* Osbeck and concluded that it was 'a nude name, published in a work not valid for nomenclature'. Although his reasons for considering OSBECK's work unavailable for nomenclatural purposes are no longer tenable under the present Code—and, moreover, it is debatable whether or not *P. adscensionis* is a nomen nudum—*Pecten* Müller is now so firmly established that it would be undesirable to revive *Pecten* Osbeck in any sense whatsoever, and application should be made to the ICZN for its suppression under the plenary powers.

29. SCHMIDT, 1818 (*Versuch Einricht. Conch.-Sammlungen*: 67), cited 'Typ. *Ostrea maxima*' for *Pecten* Lamarck, while for *Pecten* Mühlfeld he cited a different species for each of MÜHLFELD's eight sections of that genus. STEWART (1930: 34) considered that SCHMIDT fixed the type-species for *Pecten* 'since the only species designated by SCHMIDT which was in the original *Pecten* Müller is *Ostrea maxima*. . . . It is perhaps necessary to note that *O. opercularis* was doubtfully placed under *Pecten* by MÜLLER'. If this were true, SCHMIDT's designation of *O. maxima* as type-species could indeed stand, as *O. opercularis* would be excluded under the terms of ICZN Article 67(h), according to which 'a nominal species that was not included, or that was cited as a species inquirenda or a species incertae sedis when a new nominal genus was established, cannot be validly designated or indicated as the type-species of that genus'. Unfortunately, STEWART overlooked the fact that one of the sectional types given by SCHMIDT for *Pecten* Mühlfeld was *O. islandica*, which was one of the species originally included in *Pecten* Müller. SCHMIDT's designation for this genus is consequently invalid. Fortunately, the type-species designated by CHILDREN is also *O. maxima*.

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* The identity of *P. adscensionis* has never been satisfactorily established. GRANT & GALE (1931: 154–158) produced arguments intended to show that it is a species of *Chlamys* s.l., while WINCKWORTH (1934b) suggested that it might be *Spondylus powelli* Smith or a species of *Chama*. [Although THIELE (1934: 807–808) cites *Pecten* as of OSBECK and gives *P. adscensionis* as his example, it is evident from the description that his *Pecten* is the *Pecten* of MÜLLER and most subsequent authors.]

30. HERRMANNSEN, 1846 (*Indicis Gen. Malac.* **1**: 231), cited 'Typus: *Pecten islandicus* Linn.'. This is *Ostrea islandica* Gmelin, which was included by RÖDING in the synonymy of his first species *Chlamys cinnabarina* and which is identical with *Pecten islandicus* Müller. For *C. islandica*, his second species, RÖDING offered neither description nor bibliographical reference, but as he stated 'eod[em]' we may assume that he considered *O. islandica* Gmelin to comprise both his first two species *C. cinnabarina* and *C. islandica*. *C. islandica* Röding should nevertheless be considered a nomen nudum.

31. *Chlamys distorta* da Costa is commonly placed in the 'genus' *Hinnites* Defrance, 1821,* but like a number of other workers we agree with ROGER (1939: 151) that: 'La terme *Hinnites* ne peut donc avoir la valeur d'une division systématique, il s'agit de formes qui se fixant prennent un aspect ostréiform'. KOROBKOV (1957: 32) supported this view and concluded that the family Pectinidae, and particularly the subfamily Chlamysinae [sic] contains a series of polyphyletic genera which, although possessing common adaptive characters, are genetically unrelated. He suggested such names as *Hinnites* and *Pseudamussium* should be retained not as generic or subgeneric taxa but as names of adaptive forms. According to KOROBKOV, an adaptive form ('Forma accommodata') is 'an artificial group of species within a genus which has no systematic significance. It unites the species having common adaptive characters, regardless of their geologic or genetic relationships' (MULLER, 1958: 89–90).

The use of the forma accommodata *Hinnites*, however, has been criticized by ADAM (1960: 8–9). This author admitted the utility of the concept for species in which only the adaptive form is known, but rejected its use for *Chlamys distorta* for the following reason: '. . . si nous l'appliquons dans le cas de *Chlamys distorta* et que nous indiquons cette forme comme *Chlamys* (F. acc. *Hinnites*) *distorta*, nous désignons bien qu'il s'agit d'une forme fixée, mais non sa parenté avec *Chlamys multistriata*, qui resortirait d'une dénomination subspécifique *Chlamys multistriata distorta*, à moins d'y intercaler encore la dénomination d'adaptation: *Chlamys multistriata* (F. acc. *Hinnites*) *distorta*, ce qui nous amène à des noms fort compliqués'. We agree entirely with ADAM, but must point out that DA COSTA's name has priority over *multistriata* Poli.

It is also arguable that *Cyclopecten*, *Palliolum* and *Pseudamussium* are no more than formae accommodatae of *Chlamys* but, as the species here referred to those genera differ considerably in form and sculpture from the type-species of *Chlamys*, we prefer to follow current practice in regarding those taxa as distinct generic units.

32. WINCKWORTH (1932: 241) included '*Chlamys islandica scotica*' in his list on the basis of a dozen living specimens trawled in about 90 fathoms, 40 miles north-east of the Flugga lighthouse on the island of Unst in the Shetlands (SIMPSON, 1904: 66;† MARSHALL, 1913: 77). SIMPSON (1910: 110) referred these specimens to '*Pecten islandicus* Müll.— . . . a dwarf form which might be distinguished as var. *scotica*', but subsequent examination of some of SIMPSON's material by WINCKWORTH (1951: 133) indicated its identity with *C. sulcata* (Müller).

33. This species is the type, by original designation, of *Similipecten* Winckworth (WINCKWORTH, 1932: 241, 250). Its characters, however, approach so closely those of *Delectopecten* Stewart (STEWART, 1930: 118) that it is here included in the latter subgenus.

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* *Dictionnaire Sci. nat.* **21**: 169. Type-species, by selection by GRAY, 1847 (*Proc. zool. Soc. Lond.* (15): 201): *Hinnites cortesyi* [incorrectly cited by GRAY as *corteysii*] Defrance, 1821 (loc. cit.) = *Ostrea crispa* Brocchi, 1814 (*Conchiologia foss. Subapennina* **2**: 567) [Late Tertiary fossil]. *Hinnites cortesyi* is occasionally cited as the type-species of *Hinnites* 'by original designation'. DEFRANCE included two species, *H. cortesyi* and *H. dubuissoni*, but there is no indication as to which of these he considered to be the type. The first valid designation appears to be that of GRAY, 1847.

† Dated 1903, but published in 1904 *fide* SYKES & SMITH (*Zool. Rec.* **40** (7): 27).

34. According to Ockelmann (1965: 28 footnote), the larva of this species has been found in plankton from the North Sea, but we know of no record of adult specimens—alive or dead—from the British Marine Census Area.

35. The species listed by Winckworth (1932: 241) as *Chlamys* (*Pseudamussium*) *triradiata* (Müller, 1776) is, according to Soot-Ryen (1963), no more than an 'inflated, radially folded form of the very variable' *Palliolum tigerinum* (Müller, 1776). This is in agreement with the findings of the authors, who have been unable to discover any character consistently distinguishing the two forms.

36. Since the publication of Winckworth's list, emendation of the Code of Zoological Nomenclature has made available generic names originally published in connexion with an illustration, provided the other criteria of availability are also satisfied [ICZN Articles 11, 12, 16(a) (vii)].

37. Winckworth (1932: 241) included this species in the subgenus *Limaria* Link, 1807, while in a later paper (Winckworth, 1951: 133) it is transferred to *Promantellum* Iredale, 1939. The type-species of *Limaria* is *Limaria inflata* Link, 1807, by selection by Winckworth (1930b: 116). Iredale (1939: 386), however, insisted that the type must be *Limaria vulgaris* Link, 1807, by tautonymy, perhaps because Link (loc. cit.) included *Ostrea lima* L. in the synonymy of that species. This would have the effect of making *Limaria* Link a junior objective synonym of *Lima* Bruguière, and this was the reason for the substitution of *Promantellum* for *Limaria* in 1951. As neither *lima* nor *vulgaris* are tautonyms of *Limaria*, and as there is no rule in the present Code whereby type-status is automatically bestowed on species called '*vulgaris*', Iredale's reasoning on this point is not accepted here and Winckworth's selection of *Limaria inflata* Link as type-species is considered valid.*

Mantellum Röding, 1798, has from time to time been used for the *hians* group, but this seems indefensible. Winckworth (1930b) considered the type-species to be *Ostrea lima* L. by selection by Gray, 1847 (*Proc. zool. Soc. Lond.* (15): 200) and consequently regarded *Mantellum* as a junior objective synonym of *Lima* Bruguière. Gray, however, merely included *Mantellum* in the synonymy of *Lima* when citing the type-species of *Lima*, and that does not constitute a type-designation for *Mantellum* under the present Code. Setting aside a number of invalid designations of *Ostrea hians* Gmelin—a species not included by Röding—the next designation to be considered is that of Bucquoy, Dautzenberg & Dollfus, 1888 (*Mollusques marins du Rousillon* **2** (15): 53) who gave the type as: '*Radula inflata* Chemnitz' and referred to '*Pecten inflatus &c.* Chemn. *Conch. Cab.* 1784. **7**: 346, pl. LXVIII, fig. 649a'. Röding, however, based his *Mantellum inflatum* on 'Gmel. *Ostrea inflata*. sp. 70. Chemn. **7**. t.68. f.649'. As he did not specify which of Chemnitz's 'f.649' he regarded as representing his species, *M. inflatum* can only be interpreted as synonymous with *Ostrea inflata* Gmelin (based on fig. 649b). As the species designated as type by Bucquoy, Dautzenberg & Dollfus is *Lima inflata* Lamarck, a quite different species [see footnote], this designation too must be considered invalid. If there were a valid designation of *inflata* Gmelin as type, *Mantellum* would become a senior subjective synonym of *Limatula* and, as none of RÖDING's four species—*excavatum, inflatum, scabrum, lima*—is in the *hians* group (*Mantellum* auctt.) designation of any species other than *lima* as type would upset current usage [*M. excavatum* is an *Acesta*, *M. scabrum* a *Ctenoides*]. In view of the confusion associated with this generic name it is here deemed prudent to reject it altogether and to request its suppression by the ICZN under the plenary powers.

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* Winckworth's statement that *Limaria inflata* Link, 1807 = *Ostrea inflata* Gmelin, 1791, is, however, incorrect. For *L. inflata* alone of his four species of *Limaria*, Link cited no reference to Gmelin's work, reference being made only to Chemnitz, 1784 (*Neues system. Conch.-Cab.* **7**: pl. 68, fig. 649a). This is *Pecten inflatus &c.* Chemnitz [non-binominal] = *Lima inflata* Lamarck, 1807, a Mediterranean and Atlantic species of the *hians* group. *Ostrea inflata* Gmelin, on the other hand, is based on Chemnitz's fig. 649b = *Ostrea bullata* Born, 1778, a limid allied to *Limatula subauriculata* (Montagu).

Ostrea tuberculata Olivi, 1792, is based on a short description of little diagnostic value and a reference to Gualtieri, 1742 (*Index Test. Conchyl. Mus. Gualtieri*: pl. 88, fig. EE). As Chemnitz also refers to this figure in the synonymy of his *Pecten inflatus &c.*, and as *Lima inflata* Lamarck, 1807, is based solely on Chemnitz's figure 649a, the identity of *O. tuberculata* Olivi with Lamarck's species is feasible. The problems associated with the valid name of the type-species of *Limaria* are complex, however, and a fuller discussion of them is beyond the scope of this note.

38. See note **4** above. In the *Ergebnisse*, *Limea* appears on p. 623.

39. This name appears as *loscombii* on the plate and as *loscombi* in the descriptive letterpress. For a discussion of the correct taxonomic usage of the generic name *Limea* Bronn see note **41** below.

40. As *Plagiostoma* Sowerby is regarded by most authors as a subgenus of *Lima*, *Lima sulcata* Brown, 1827 (*Illustrations Conch. Great Britain & Ireland*: pl. 31, figs. 4–5), is preoccupied by *Plagiostoma sulcata* Lamarck, 1819 (*Histoire nat. Anim. sans Vertèbres* **6** (1): 161). JEFFREYS, 1864 (*British Conchology* **2**: 81), named this species *Lima elliptica*, but this too is preoccupied—by *Lima elliptica* Whiteaves, 1861 (*Ann. Mag. nat. Hist.* (3) **8**: 146), as pointed out by SYKES, 1903 (*J. Malac.* **10**: 104), who renamed it *Lima gwyni*.

41. *Limea* Bronn has been used by a number of authors, including WINCKWORTH (1932: 241), for a well-defined group of limids—including *L. sarsii* Lovén—in which the hinge-plate is distinctly toothed, the valves are equilateral and not gaping, and the external sculpture is characteristic. As has been pointed out by JEFFREYS (1864: 79–80) and THIELE (1934: 810–811), however, the type-species of *Limea* is *Ostrea strigilata* Brocchi, an Italian Tertiary fossil allied to our *L. loscombi* and which does not possess the taxonomic characters of *Limea* auctt., albeit *L. loscombi* may occasionally show traces of tooth-like structures on the hinge-plate. Good figures of the hinge of *L. sarsii* and *L. strigilata* are given by JENSEN (1912: pl. 2, fig. 11) and SORGENFREI (1958: pl. 6, fig. 26) respectively.

Limoarca Münster, 1832 (*Jb. Miner. Geogn. Geol. Petrefaktenk.* **3**: 421), is usually cited as a synonym of *Limea* Bronn, but should more probably be considered a synonym of the Mesozoic genus *Pseudolimea* Arkell (in DOUGLAS & ARKELL, 1932: 161).* This name is not applicable to the group of *L. sarsii*.

THIELE (1934: 810)† has suggested that *Notolimea* Iredale, 1924—type-species *Lima australis* Smith—should be used for *Limea* auctt. non Bronn. In his original description of *Lima australis*, SMITH states that the hinge-line is 'much thicker than in the European *L. sarsii*, and the transverse toothing more distinct'. Unfortunately, only the outside of the shell is figured, and the present authors have not yet seen the type-specimen. The shape and sculpture of *N. australis* is, however, very like that

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[*] The name *Limoarca* was established without included nominal species in MÜNSTER's 'Mittheilungen an Professor Bronn' in which MÜNSTER asks BRONN for information about a Jurassic bivalve in the following words: 'Ist ihnen die Bivalve aus dem oolithischen Thoneisenstein bekannt, welche eine eigene Gattung zwischen *Lima*, *Arca* und *Plagiostoma* zu bilden scheint? In der Schlosslinie zeigen sich förmliche Zähne und Grübchen, wie bei einer *Arca*, während die Bivalve die Gestalt einer *Lima* oder *Plagiostoma* hat! Vorläufig bis zur Untersuchung von mehreren Exemplaren habe ich diese Bevalve [sic] *Limoarca* gennant'. To this, BRONN replied in a footnote: 'Diese Art kenne ich nicht, aber dieser Beschreibung sehr entsprechend ist die tertiäre *Ostrea strigilata* Brocchi's, welche ich in meiner Abhandlung über "Italiens Tertiärgebirge etc." S.115, als Genus *Limea* aufgestellt habe'. MÜNSTER apparently accepted BRONN's tentative opinion, for what is almost certainly this species was published as *Limea duplicata* Münster, in GOLDFUSS (1836: 103, pl. 107, fig. 8). The locality is given as 'aus dem oolitischen Toneisenstein von Thurnan' and the excellent figures correspond well with the description of *Limoarca*, though that name is nowhere mentioned. COX (1944) referred *Limea duplicata* to the genus *Pseudolimea* Arkell, 1932.

[†] THIELE includes *Lima crassa* Forbes, 1838, an Aegean species accepted by a number of continental authors as a senior synonym of *L. sarsii* Lovén, 1846. It is here considered a nomen dubium.

of *N. sarsii*. Both are cold, deep-water species, *N. australis* being taken by the 'Challenger' Expedition at Station 164 B, off Sydney in 410 fathoms.

42. The arrangement of SCHMIDT's *Versuch Einricht. Conch.-Sammlungen* and the type-designations contained therein have been discussed by STEWART (1930: 33–35) and WINCKWORTH (1944). SCHMIDT designated *Anomia ephippium* as type of *Anomia* Lamarck and the same species as type of *Anomia* Mühlfeld. Under the terms of ICZN Article 67(g) this action also constitutes a valid type-designation for *Anomia* L., since *A. ephippium* was an eligible species.

43. *Operculella* Monterosato, 1915 (*Ann. Mus. civ. Stor. nat. Genova* **47**: 15), may be an earlier name for *Heteranomia* Winckworth, 1922, but is here considered a nomen dubium.

44. WINCKWORTH (1932: 240) also listed *Crassostrea virginica* (Gmelin, 1791). This species was imported from the U.S.A. for re-laying in British beds but never became naturalized. No imports have been made since 1939 and it is now presumed to be extinct in this country, although old, empty shells may still sometimes be found. As further imports of American shell fish are prohibited under Article 4(1) of the Molluscan Shellfish (Control of Deposit) Order 1965 and the Molluscan Shellfish (Control of Deposit) Order (Scotland) 1965, which came into force on 1 January 1966, it is unlikely that the species will again be introduced into British waters.

45. This is apparently the first record of living specimens of this species from the British Marine Census Area. Four specimens attached to an empty *Colus* shell were dredged in 94 fathoms at 'Sarsia' station 377 C, 50°13′N. 10°42′W. on 17 June 1964. When first brought up, a live *Capulus ungaricus* (L.) was still attached at the edge of the largest specimen. This may be a new host record for *Capulus*, as it is not recorded as living on *Pycnodonte* by FRETTER & GRAHAM (1962) or THORSON (1965).

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NOTES ON TWO COLONIES OF *CEPAEA NEMORALIS* (L.) POLYMORPHIC FOR WHITE LIP

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(*Read before the Society*, 13 *November* 1965)

1. ANNACOONA

The colonies of *Cepaea nemoralis* (L.) on the cliff of Annacoona, a limestone outcrop in the Dartry Mountains, Co. Sligo, were described by Comfort (1945) and have been considered in more detail by Cook & Peake (1960), following a survey carried out in August 1958. The topography is such that a small population on exposed rock is sometimes separated from others by several yards of peat bog, which forms a barrier to the snails. Usually, careful search would reveal twenty to thirty individuals in such areas of relatively high density, and these patches we called 'colonies'. The whole complex is separated by over a mile of capping peat bog from its nearest neighbours on Benwhiskin, where the snails differ in several respects.

In August 1962 I re-collected in the area with a view to obtaining material for breeding purposes, and of increasing the information available as to the association between lip colour and other shell characters. The results of the survey are described briefly below.

Colour and Banding

When the cliff was sampled in 1958 the snails at the southern end appeared to be largely pink unbanded, while on the northern face the two colonies were predominantly yellow banded. Throughout the area abrupt changes occurred from one site to the next. The situation observed in 1962 is summarized in Tables 1 and 2.

At that time there was still a higher frequency of yellow banded shells on the northern face than elsewhere, but the difference between colonies was no longer so marked. The frequency of yellow in the sample from colony 5 had fallen from 100%, and the samples from the four most southerly colonies (29,

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Table 1. Comparative frequencies in 1958 and 1962. In **a** and **b** the numbers include juveniles. Colonies are arranged with the most northerly at the top, the most southerly at the bottom. Asterisks indicate a significant change in frequency $(P < 0{\cdot}05)$

	a				b		c			
	Frequency of Yellow				Frequency of Banding		Frequency of White Lip			
	1958		1962		1958	1962	1958		1962	
COLONY	NUMBER	%	NUMBER	%	%	%	NUMBER	%	NUMBER	%
22	38	89	65	86	53	80*	38	5	58	12
5	34	100	10	70	97	80	34	0	9	0
21	20	50	18	28	10	0	20	65	15	53
25	22	32	37	41	5	8	22	46	18	11*
27	55	38	90	16*	5	4	55	47	31	29
31	31	42	27	15*	6	4	31	45	16	38
30	44	7	76	9	2	3	44	14	19	21
29	18	6	72	18	0	3	18	100	18	33*

30, 31, 27) show much greater similarity in this respect—between 9% and 18% yellow where formerly the range was from 6% to 42%. The changes in the samples from colonies 27 and 31 are statistically significant. In other cases the numbers are too small for differences to be detected. These comparisons have been made using combined data for adults and pre-adults in 1962, no significant differences being found between the two groups. In the sample from colony 27, however, the difference is quite great, and there appears to be a progressive fall in the incidence of yellow from 1958 adults (38%) to 1962 adults (23%) to 1962 juveniles (12%).

Only one of the changes in banding frequency—that for the sample from colony 22—was found to be significant. On Benwhiskin, where reasonably large numbers were obtained on both occasions, the frequency of both colour and banding is almost identical in the two samples.

Lip Colour

The mean frequency of the white-lipped phenotype had dropped from 40% in 1958 to 25% in 1962. Changes observed in individual colonies are shown in Table 1c, where the greatest fall in frequency is seen to occur in the samples from colonies 29 and 25. As with yellow, the change in the southern part of the exposure has brought the frequency in colonies 29 and 30, on the one hand, closer to that in colonies 27 and 31 on the other.

Associated with the increase in banding, the increase of white lip is much lower

Table 2. Animals collected in 1962 on Annacoona and Benwhiskin

	COLONY								
	22	5	21	25	27	31	30	29	Benwhiskin
a ADULTS									
PINK UNBANDED BROWN LIP	0	2	6	9	17	9	15	11	9
PINK UNBANDED WHITE LIP	0	0	6	1	7	4	3	5	0
PINK BANDED BROWN LIP	9	1	0	0	0	0	0	0	49
PINK BANDED WHITE LIP	0	0	0	0	0	0	0	0	0
YELLOW UNBANDED BROWN LIP	7	0	1	4	5	0	0	1	15
YELLOW UNBANDED WHITE LIP	5	0	2	1	2	2	1	1	0
YELLOW BANDED BROWN LIP	35	6	0	3	0	1	0	0	27
YELLOW BANDED WHITE LIP	2	0	0	0	0	0	0	0	0
b JUVENILES									
PINK UNBANDED	0	0	1	12	52	10	51	43	—
PINK BANDED	0	0	0	0	0	0	0	0	—
YELLOW UNBANDED	1	0	2	7	3	1	4	9	—
YELLOW BANDED	6	1	0	0	4	0	2	2	—

in the samples from the northern face than elsewhere. In 1962, as in 1958, the distribution of lip colour between banded and unbanded individuals is highly non-random ($P < 0{\cdot}001$), while there is no significant difference between the frequencies of white lip among pinks and yellows. There is thus a strong association between lip colour and banding (Table 3).

Table 3. 1962 samples

	PINK UNBANDED	PINK BANDED	YELLOW UNBANDED	YELLOW BANDED
BROWN LIP	69	10	18	45
WHITE LIP	26	0	14	2

When all the data for the two years are combined, the banded, white-lipped phenotype is seen to be extremely rare: less than 3% of all white-lipped individuals, where 23% would be expected on the basis of independent assortment in the absence of selection (Table 4).

Table 4. 1958 and 1962 samples combined

	UNBANDED	BANDED
BROWN LIP	231	119
WHITE LIP	180	5

2. MALHAM

In August 1958, Mr L. W. STRATTON collected a sample of *C. nemoralis* from Green Hill Scar on Fountain's Fell near Malham Tarn, Yorkshire (STRATTON, 1959). Like the Dartry Mountains, this region is a dissected plateau of which a large part is Carboniferous Limestone with areas of shales and Millstone Grit. STRATTON (1956) had already made a general survey of the Mollusca and found *C. nemoralis* to be not uncommon. Lip colour was typical for the species in all of fifteen colonies except that on Green Hill Scar. There, all the individuals were yellow, and fell into the following groups as regards lip pigmentation and presence or absence of bands (Table 5).

Table 5. 1958 samples

	UNBANDED	BANDED
BROWN LIP	41	0
WHITE LIP	14	67

In the white-lipped category the peristome is unpigmented. The others sometimes have a paler lip than is usual for the species. In June 1961 I collected another sample on the outcrop, for which the numbers in the four classes are given in Table 6. These animals were scored and returned to the colony. In May 1963 a third sample was sought. This time very few individuals could be found. The adults were distributed as in Table 7; if juveniles are added there were 19 unbanded snails in a total of 24. The two subsequent samples do not differ from each other and, although the frequency of white-lipped individuals in the banding classes is unchanged between them and the first sample ($P > 0{\cdot}25$), there is a highly significant drop in the frequency of bandeds ($P < 0{\cdot}001$). The association between lip colour and banding is complete, but it is in the reverse direction to that at Annacoona.

Table 6. 1961 samples

	UNBANDED	BANDED
BROWN LIP	31	0
WHITE LIP	18	14

Table 7. 1963 samples

	UNBANDED	BANDED
BROWN LIP	11	0
WHITE LIP	5	4

INHERITANCE OF WHITE LIP

An unbanded brown-lipped individual from Malham, when crossed with a banded brown-lipped snail from a colony in Wales, gave progeny segregating for banding. Although these offspring are not yet adult, we can say that the Malham parent was heterozygous for banding, so that on the evidence of the samples it was most probably heterozygous for lip colour also. It follows that white lip is recessive to normal pigmentation. Similarly, a banded white-lipped snail from Malham crossed with an individual from Leicestershire has so far produced two brown-lipped offspring. Matings have been made up with which it is hoped to show the linkage between this factor and the colour and banding loci.

DISCUSSION

In both localities the composition of the later samples differs quite markedly from the earlier ones. In many cases the differences are statistically significant. Thus, at Annacoona the probability of drawing both groups of pinks and yellows at random from the same population is less than 2%. The position of the colonies at Annacoona, however, was not established trigonometrically for future reference, and two different collectors took the early and late Malham samples. In both cases errors could have arisen through the procedure adopted, so that no inferences will be drawn from the apparent changes in morph frequency.

This stricture does not apply to the data on lip colour, because there was little change with time, and the most notable feature of this character is the disequilibrium within the samples. The situation could, in part, be due to linkage If the lip colour locus is closely linked to banding the rate at which the gene for white lip was distributed among the different colour and banding classes would be slowed down. The degree of linkage has not yet been determined, but it cannot be much closer than that between colour and banding; and at Annacoona the four allelic combinations at the two latter loci appear to be present in something near the proportions to be expected if the factors determining their frequencies are independent. It is necessary, therefore, to assume either (a) that lip colour and banding are very closely linked and that white lip is present in the colonies as a result of mutations occurring in the recent past on both yellow unbanded and pink unbanded chromosomes, but not in the other two karyotypes, or (b) that the fitness of an individual in which pale lip and unbanded genes are present together is radically different from that of one carrying white lip and banded genes. The existence of the white lip character in many Irish colonies suggests that it is of considerable antiquity in the area, rather than a recent local mutation. The presence of this character in one of the two localities studied exclusively in the coupling phase with banding, but in the repulsion phase in the other, indicates that different combinations are at a selective advantage in the two areas. No suggestion can be made at present as to why this should be so, nor why a white peristome should be found only in small colonies in the British Isles, often situated on limestone uplands.

ACKNOWLEDGMENTS

I wish to thank Mr R. W. ARNOLD and Mr L. W. STRATTON for their helpful comments. The work was assisted by a grant from the PRAEGER Fund of the Royal Irish Academy, for which grateful acknowledgment is made.

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J. Conch. **26**: 131–134. (1966)

STATISTICS IN NORTH-WEST AMERICAN *PUSULA* JOUSSEAUME (TRIVIIDAE)

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(*Read before the Society,* 11 *December* 1965)

In Easter week, 1965, Professor JERRY DONOHUE of Los Angeles, and his daughter NORA, collected shells on the beach of Puerto Peñasco at the northern end of the Gulf of California. Among the Triviidae—which formerly have been united with the Cypraeidae, but which must now be removed to the Lamellariacea for anatomical reasons—there were three species all belonging to the genus *Pusula* Jousseaume, 1884; viz 157 *P. solanderi* (Sowerby, 1832)*, 75 *P. californiana* (Gray, 1827) and two small shells which probably belong to *P. myrae* (Campbell, 1961) if that species is separable from *P. fusca* (Sowerby, 1832) The great number of specimens, especially of *P solanderi*, challenges statistical investigation.

In the 157 *P. solanderi* the variation in length exhibits two maxima. If arranged in sixteen classes of 0·5 mm, the classes from 10.0 mm to 17.5 mm are represented by:

10·0	10·5	11·0	11·5	12·0	12·5	13·0	13·5	14·0	14·5	15·0	15·5	16·0	16·5	17·0	17·5	**length(mm)**
2	4	4	6	10	15	16	21	14	11	25	9	7	8	4	1	**specimens**

The two maxima, at 13·5 mm and at 15·0 mm, may be caused by sexual differences or by the beach shells belonging to two populations living in different depths of the sea or influenced by other differences of environment. The dimorphism in length is even recognizable if the shells are arranged in classes of 1·0 mm from 10 to 17 mm:

10	11	12	13	14	15	16	17	**length (mm)**
3	9	20	34	33	34	18	6	**specimens**

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* Professor SCHILDER maintains that the original spelling '*solandri*' should be emended to '*solanderi*'—which latter spelling has been employed by him in earlier papers—as 'a latinization of a relatively modern English name seems inadmissible'. In the absence of a definite ruling on this point by the ICZN—there is only a non-retroactive recommendation in Appendix D III 16—it seems better to regard the original spelling as the correct form of the genitive. It may be relevant to add that LINNAEUS, who was a friend and correspondent of SOLANDER's, also used the spelling '*solandri*' [e.g. *Systema Naturae*, ed. 10 **1**: 2]. —Editor.

The variation in relative breadth (expressed as % of length), however, shows one broad maximum only, ranging from 70% to 73% with 22 to 24 shells in each class. There is no correlation of length (in mm) with relative breadth (in classes of 3%):

length (mm)

relative breadth (%)	10	11	12	13	14	15	16	17	
78	1	1	—	2	1	1	—	—	6
75	—	1	6	10	10	5	3	—	35
72	1	6	6	10	14	20	10	3	70
69	1	1	6	12	7	8	5	3	43
66	—	—	2	—	1	—	—	—	3
	3	9	20	34	33	34	18	6	

Table 1

There is, however, a distinct positive correlation of the length of shell with the number of ribs crossing the margins, which varies from 28 to 42. The mean is 34 ribs, the limits of two-thirds of the shells approaching the mean are 32 and 36. In Table 2 the lengths have been arranged in classes of 1.5 mm and the ribs in classes of 3.

length (mm)

ribs	10·5	12·0	13·5	15·0	16·5	18·0	
42	—	—	—	1	—	—	1
39	—	—	1	3	4	1	9
36	1	9	16	11	10	—	47
33	3	14	28	28	5	—	78
30	5	8	6	2	—	—	21
27	1	—	—	—	—	—	1
	10	31	51	45	19	1	

Table 2

The labial teeth bordering the aperture are formed by the ribs crossing the outer lip and by short denticles intercalated in the interstices between some ribs; these denticles are peculiar to *P. solanderi* and are always absent in the allied *P. radians* (Lamarck, 1810). The total number of labial teeth varies from 14 to 22, forming the histogram:

14	15	16	17	18	19	20	21	22	**teeth**
1	8	33	45	43	21	4	1	1	**specimens**

The positive correlation of the length of shell with the total number of labial teeth is rather indistinct, as the median number of teeth in the six classes of length distinguished above is:

10·5	12·0	13·5	15·0	16·5	18·0	**length (mm)**
16	17	17	18	18	(17)	**median no. of teeth**

But there is a distinct negative correlation of the number of labial ribs becoming teeth along the aperture with the intercalated denticles (Table 3). The number of denticles replacing the ribs is variable, but they are never totally absent as in *P. radians*.

ribs

		11	12	13	14	15	16	17	
	7	—	—	—	—	1	—	—	1
	6	1	2	4	—	—	—	—	7
	5	1	5	8	8	1	—	—	23
denticles	4	1	10	15	23	8	3	1	61
	3	—	4	15	18	7	—	—	44
	2	—	—	2	7	4	3	1	17
	1	—	—	1	1	—	2	—	4
		3	21	45	57	21	8	2	

Table 3

In another population of *P. solanderi* (43 shells), collected in the Gulf of California by NEWCOMB (in coll. TEN KATE, now in the Rijksmuseum, Leiden), there is one maximum of length only (at 13·0 mm):

10·0	10·5	11·0	11·5	12·0	12·5	13·0	13·5	14·0	14·5	15·0	**length (mm)**
1	0	2	1	5	8	10	8	3	4	1	**specimens**

Otherwise the shells vary in a similar way, although the negative correlation of the labial ribs with the intercalated denticles is also distinct (Table 4).

ribs

		11	12	13	14	15	16	
	6	—	1	—	—	—	—	1
	5	1	3	—	1	—	1	6
denticles	4	1	1	1	4	2	—	9
	3	1	1	5	5	5	—	17
	2	—	—	—	2	4	4	10
		3	6	6	12	11	5	

Table 4

The 75 *Pusula californiana* from Puerto Peñasco and 21 *P. californiana* collected by JERRY DONOHUE at Corona del Mar, 30 miles south of Los Angeles, are practically identical in length (the mean is 9·4 mm and 9·2 mm respectively), but the latter differ by their brown instead of pinkish-purple colour and by being broader, with the marginal ribs and the sum of labial and columellar teeth far less numerous. The median (in parentheses) and the standard limits of two-thirds of specimens are:

	PUERTO PEÑASCO			CORONA DEL MAR		
length (mm)	8·5	(9·4)	10	7·5	(9·2)	10·5
relative breadth (%)	75	(76)	79	78	(79)	81
marginal ribs	37	(40)	43	30	(33)	36
teeth of both lips	25	(27)	29	23	(25)	27

There is a distinct positive correlation of the number of marginal ribs with the sum of the teeth on both lips:

30	33	36	39	42	45	**marginal ribs**
24	25	25	27	28	30	**median no. of teeth**

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KENNARD'S RECORD OF FOSSIL *HELIX NEMORALIS* L. IN ORKNEY

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(*Read before the Society*, 13 *November* 1965)

The present northern limit of range of *Helix nemoralis* L. in the British Isles is Kincardineshire on the east coast of Scotland and Skye on the west. A record of the species from Orkney—so far north of its present range—is of interest, therefore, and this note is intended to elucidate it.

The record seems to have escaped attention as it appeared in a geological paper dealing with Irish material (KENNARD & WOODWARD, 1917: 169). It runs: 'This species [*H. nemoralis*] inhabited N. Ronaldshay, Orkney, within the historic period, but its supposed extinction has not been through the agency of the other molluscan inhabitants'. The specimens, thirteen in number [Pl. 6, fig. 1], were collected by Dr W. TRAILL when excavating the mound called Stenabreck, in North Ronaldsay, and were seen by Dr FRANK CORNER in the National Museum of Antiquities of Scotland and also by KENNARD. The mound contained structures which—from the pottery—are of late Norse date (say thirteenth to fourteenth century), according to Mr R. B. K. STEVENSON. The shells have been submitted to Mr A. W. STELFOX and Mr A. R. WATERSTON and both agree that they are specimens of *Helix hortensis* Müller and not *H. nemoralis*, as far as one can be certain without seeing the darts. The ten adult shells are white-lipped, nine are banded, and one is var. *lutea*.

It is possible that KENNARD, unused to Scottish material of *H. hortensis*, wrongly attributed the shells to *H. nemoralis* and later realized his error. Although no retraction (as far as I know) was ever made, the record is not given in the Census, which suggests that KENNARD wished to withdraw it. Some shells of *Helix* sp. from another site in North Ronaldsay (W. TRAILL, 1885; J. TRAILL, 1890) have also been examined [Pl. 6, fig. 2], and may be mentioned here as they do not seem to have been recorded. These were from Howmae, a group of huts of pre-Viking plan in which bone weaving-combs were found. These shells, seventy in number, are smaller and more conical than those from

Stenabreck and are curious *H. hortensis*; they were not seen by Kennard. Some are very thick and many have unusual coalesced bands. Three dead shells taken on Howmae in August 1958 are all banded: their three different band-patterns are all represented in Traill's Howmae material—notably one which, in my experience, is very uncommon.

H. hortensis is not common on North Ronaldsay at the present time: two visits in 1958 and 1964 produced only three living specimens, taken near the lighthouse at the north end of the island. These specimens were all 5-banded.

Acknowledgments

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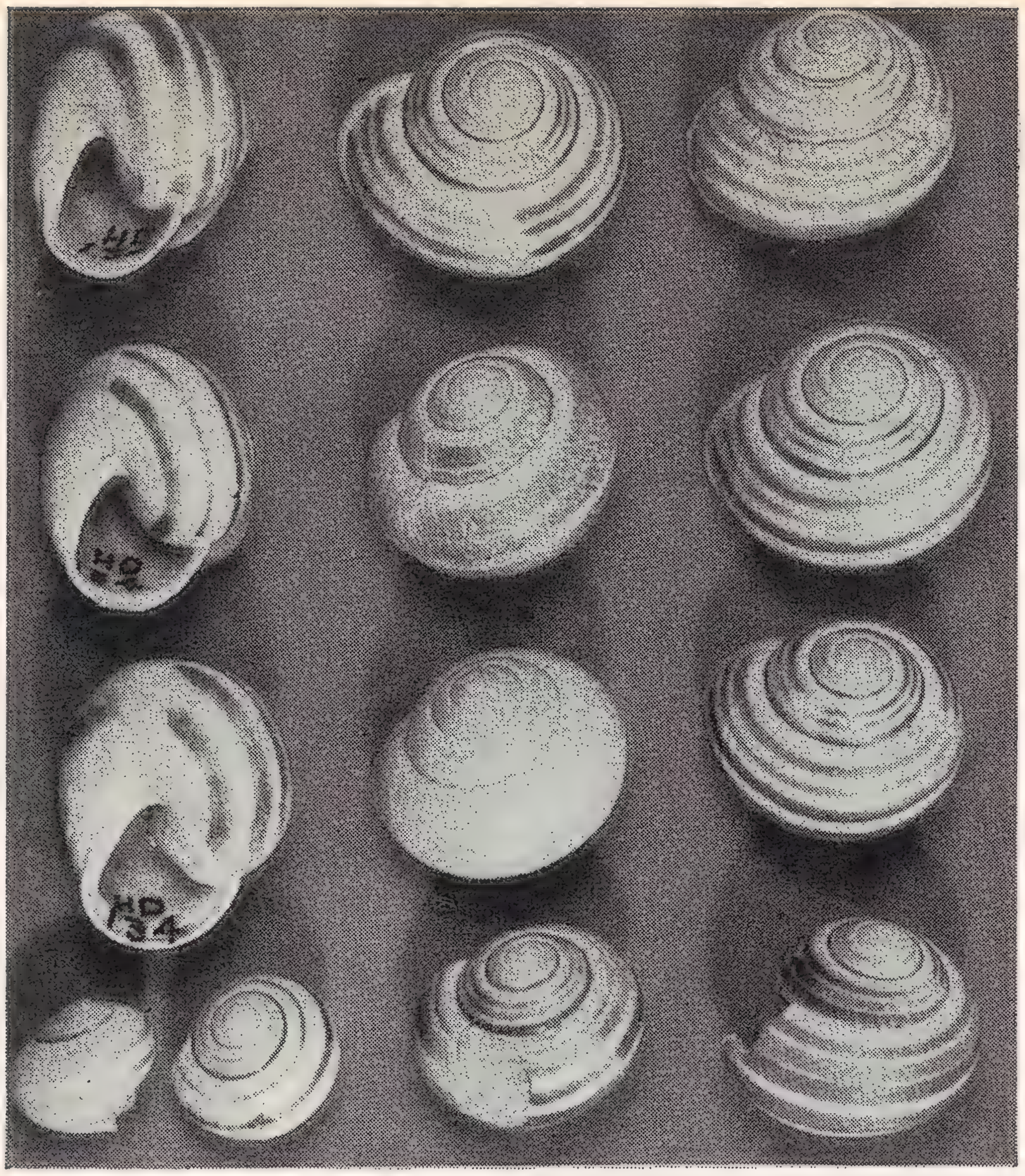
Explanation of Plate 6

Figure 1. *Helix hortensis* L. from an early domestic structure, Stenabreck, North Ronaldsay, Orkney. These are the shells determined by A. S. Kennard as *H. nemoralis* and recorded as such in *Proc. Geol. Ass.* **28**: 169 (1917). Specimens in National Museum of Antiquities of Scotland. × 1$\frac{1}{5}$.

Figure 2. *Helix hortensis* L. from a group of huts imbedded in a mound, Howmae, North Ronaldsay, Orkney. Kennard did not see these. Specimens in National Museum of Antiquities of Scotland. × $\frac{4}{5}$

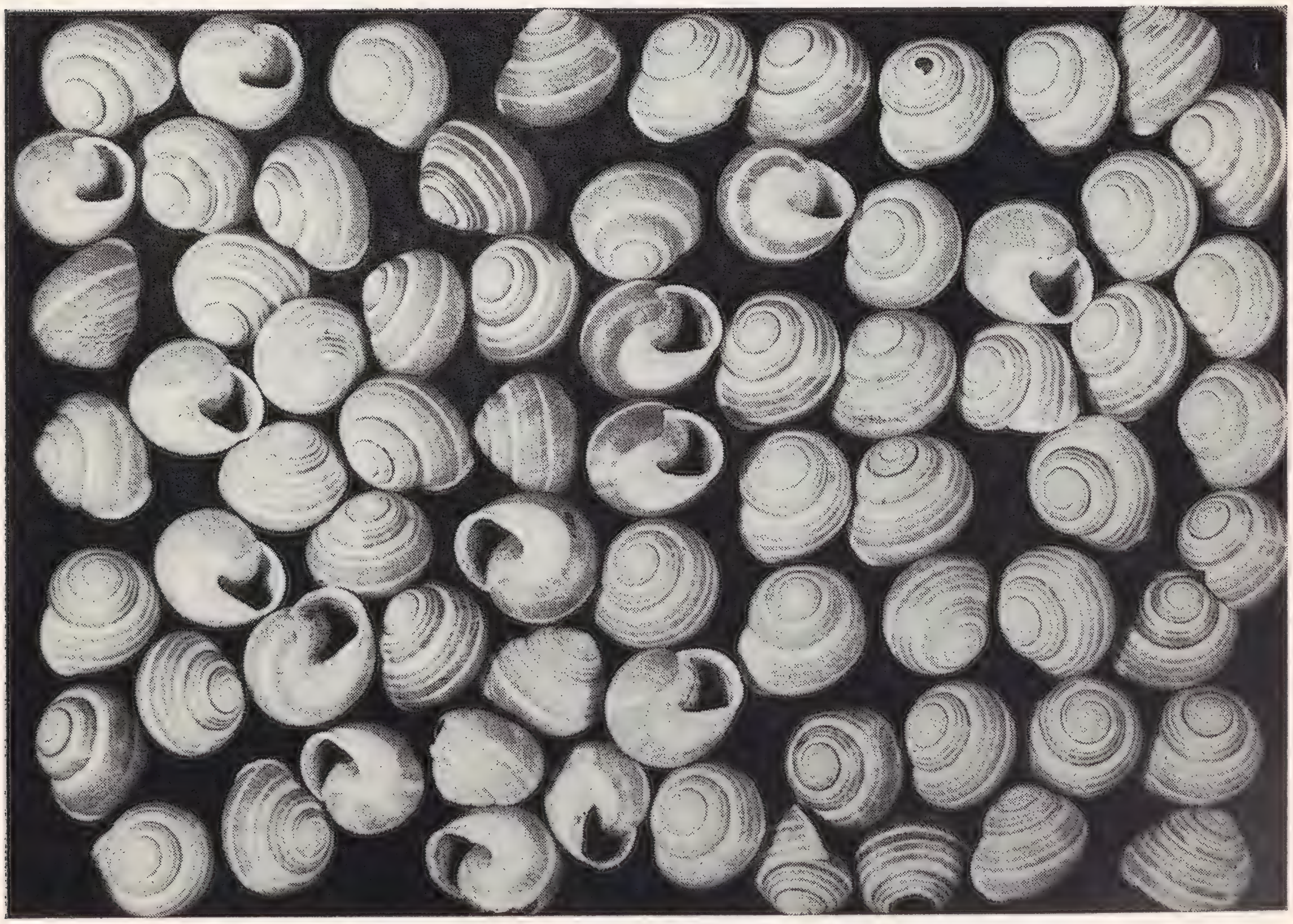


Left

Fig. 1. *Helix hortensis* from an early domestic structure, Stenabreck, North Ronaldsay, Orkney. These are the shells determined by A. S. KENNARD as *H. nemoralis* and recorded as such in *Proc. Geol. Ass.* **28**: 169 (1917). × 1⅕.

Below

Fig. 2. *Helix hortensis* from a group of huts imbedded in a mound, Howmae, North Ronaldsay, Orkney. × ⅘.



J. Conch. **26**: 137–139. (1966)

A NEW SPECIES OF *LITTORINA* FROM EILAT, ISRAEL, AND NOTES ON ITS AFFINITIES WITH *LITTORINA NOVAEZELANDIAE* REEVE

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(*Read before the Society*, 14 *November* 1964)

Littorina urieli n. sp. [Pl. 7, figs. 1–2]

Shell small, globose, with six whorls; body whorl about $\frac{3}{4}$ of the total height, very bluntly keeled, bluish-white in colour, finely but distinctly grooved, with about twelve grooves above the keel and eight below; spire darker, apex sharp and dark brown to black in colour; mouth pyriform, lip buff to white on the outer rim but chocolate brown on the columellar side where there is a strong, distinct, curved groove which continues almost to the base of the aperture; the inside of the shell is pale brown with a buff band just below the middle line which descends sharply as it approaches the mouth.

Height 7·4 mm, maximum diameter 5·0 mm.

Holotype in the British Museum (Natural History) [Reg. No.: 1966121]; paratypes in the Museum of the Hebrew University, Jerusalem, Israel and in Biggs Collection.

The proposed new species was collected by Mr Uriel Safriel whilst making ecological studies of the intertidal zone at Eilat on the Gulf of Eilat at the northern end of the Gulf of Aqaba, and later by other workers. The holotype and larger paratypes were collected 20 October 1964; the remainder of the type-series—which is considerably smaller and may be juveniles—was taken on various dates in 1961.*

In a paper on the intertidal zone of Eilat, Safriel & Lipkin (1964) refer to this species as *Littorina* (*Melaraphe*) *novaezelandiae* Reeve. It was my first impression that the shell under consideration was indeed a subspecies of *L. novaezelandiae* Reeve, and further study of the habitat and distribution of this species and its response to certain ecological conditions may prove this to be the case; in the meantime I propose to let the form stand as a species.

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* Since the above was written three examples of this proposed new species have been collected by Mr Philip Cambridge at Little Aden, S. Arabia. He notes: ‘in hot pools at high water mark’. This is exactly the type of locality in which one can expect to find it.

Littorina novaezelandiae was described by REEVE in volume 10 of the *Conchologia Iconica* (*Littorina* sp. 74, figured on pl. xiv, fig. 74); the page is dated 1857. After describing the shell REEVE writes: 'Hab. New Zealand. Curiously resembling *L. africana* in colour and marking, but lighter and rounder in form'. In the margin of the copy of this work in the British Museum (Natural History) is written in pencil 'named *erronea* by NEVILL. Hab. Ceylon', and Mr S. P. DANCE assures me that this is EDGAR SMITH's handwriting.

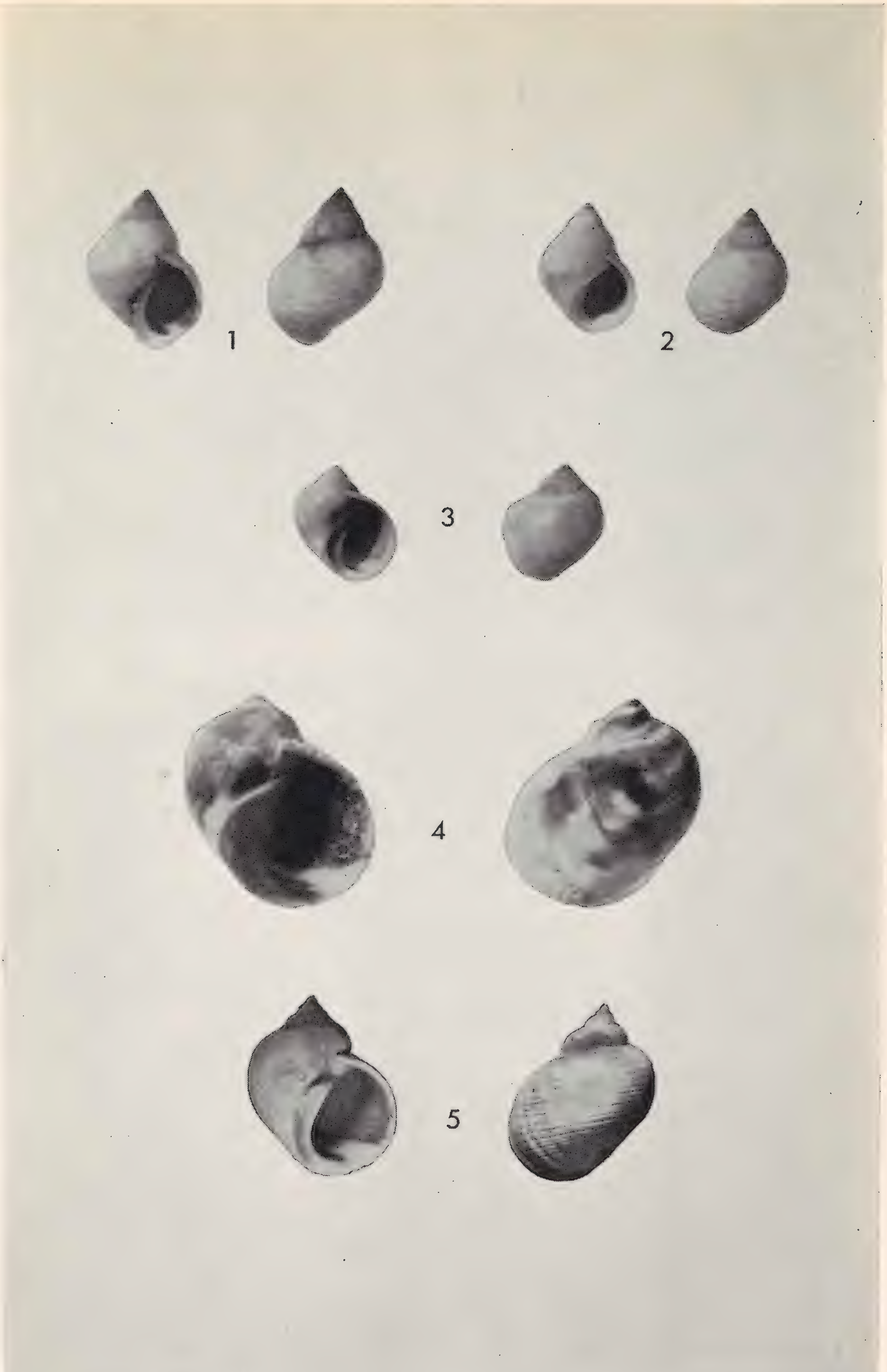
After REEVE the only references to this species as a New Zealand species are in works written on the Mollusca of that country before the beginning of the present century. For example, HUTTON (1880: 79) simply refers to REEVE's figure and quotes his description. MARTENS (1872: 27), having referred to REEVE's record adds: 'also from Auckland, by G. v. FRAUENFELD'. All important works available to me which have been written since 1900 make no mention of the species.

There lie in the British Museum (Natural History) two sets of shells—amongst others unlocated—bearing the name *Littorina* (*Melaraphe*) *novaezelandiae* REEVE, both collected by R. WINCKWORTH at Trincomali on the east coast of Ceylon. One series of twelve examples is similar to REEVE's type in many respects and was collected 25 November 1928 [Pl. 7, fig. 4]. Unfortunately the shells are rather corroded, and the mouth is much wider than the typical form; they are possibly all females. The second series, of nine examples, was taken 12 December 1926 [Pl. 7, fig. 3] and more closely resembles the Eilat specimens but differs in a few, small details. In the absence of any notes by WINCKWORTH as to the exact type of locality from which these two samples came and of any evidence of the ecological environment of either, speculation is idle. Suffice it to underline the fact that here are two series of shells from the same general area, both of which WINCKWORTH considered to belong to the species *L. novaezelandiae* Reeve, and yet one is closer to REEVE's type and the other to the Eilat form. This can be interpreted as evidence that there are two distinct species or that at one point at least in Ceylon ecological conditions are the same as at Eilat and so produce the same mutation.

The specimen in REEVE's type-series most resembling his pl. xiv, fig. 74 is **here selected as lectotype** [Pl. 7, fig. 5]. Compared with REEVE's type-series *L. urieli* n. sp. is much smaller, the spire is higher in proportion to the body whorl, the suture is shallower, and there is a slight but definite carination. Three of the larger paratypes of *L. urieli* measure 6·4 mm × 4·8 mm, 6·6 mm × 4·3 mm, and 6·4 mm × 4·3 mm. The three paralectotypes in REEVE's set measure 12·4 mm × 10·5 mm, 12·7 mm × 10·2 mm, and 12·4 mm × 9·5 mm. Some of the paratypes of *L. urieli* collected on the earlier date are young and show a stronger keel, and the colour varies from pure white or cream to bluish-white.

Although MARTENS (1873) supports the suggestion that *L. novaezelandiae* is

Plate 7



1, 2. *Littorina urieli* Biggs
3–5. *Littorina novaezelandiae* Reeve

a New Zealand species, I am obliged to suggest, on the present evidence, that Reeve was mistaken as to the provenance of the shells before him. The examples collected by Winckworth, the pencil note by E. A. Smith and the very close relationship between that species and the proposed new one, must outweigh the other evidence and all point to the fact that *L. novaezelandiae* is an Indian Ocean species and very probably from the more northern waters thereof.

In studying the Mollusca from the Erythro-Farsian Sub-Region (i.e. Red Sea to Persian Gulf) of the Indo-Pacific Region I have noticed that species distributed throughout its length tend to become smaller there than in the rest of the Indian Ocean, and the species under examination bears out this contention. The waters there are warmer and more saline, and they cause the Mollusca to reproduce as sexually mature before reaching full growth in size. Further examination of the ecology and anatomy of *L. urieli* and of samples from Winckworth's Ceylon locality will be needed before much more can be said as to the exact taxonomic position of this smaller form.

Mr U. Safriel informs me (*v. v.*) that when comparing this new species with *Littorina neritoides* (L.) and *L. punctata* (Gmelin) with respect to their sensitivity to light, *L. urieli* is much stronger in its reactions.

Acknowledgments

My best thanks are due to Mr Norman Tebble of the British Museum (Natural History) for allowing me to examine the shells under his care and for arranging for the necessary photographs to be taken. Also to Mr U. Safriel and his colleagues for collecting and placing at my disposal the material here reported on.

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Reeve, L. A., 1857. *Conchologia Iconica* **10** (*Littorina*): pl. 14, fig. 74. London.

Safriel, U. & Lipkin, Y., 1964. On the intertidal zonation of the rocky shores at Eilat (Red Sea, Israel). *Israel J. Zool.* **13**: 187-190.

Explanation of Plate 7

Figure 1. *Littorina urieli* Biggs: holotype. Eilat, Israel, *leg.* U. Safriel, 20 x 1964. BMNH 1966121.

Figure 2. *Littorina urieli* Biggs: paratype. Eilat, Israel, *leg.* U. Safriel, 20 x 1964. Biggs Coll.

Figure 3. *Littorina novaezelandiae* Reeve. Trincomali, Ceylon, *leg.* R. Winckworth, 12 xii 1926. BMNH 1966122.

Figure 4. *Littorina novaezelandiae* Reeve. Trincomali, Ceylon, *leg.* R. Winckworth, 25 xi 1928. BMNH 1966123.

Figure 5. *Littorina novaezelandiae* Reeve: lectotype. Locality 'New Zealand' thought to be incorrect. BMNH 1966124.

REVIEW

The Young Specialist looks at [Land and Freshwater] Molluscs by HORST JANUS. [Translated and adapted from *Unsere Schnecken und Muscheln* Stuttgart, 1958.] London: Burke, 1965. pp. 180, 4 pls. (2 in colour), 34 + 164 text-figs. *The Young Specialist* series, No. 12. 8vo. Price 12s 6d, or 7s 6d (paperback).

This is the English version of the same author's *Unsere Schnecken und Muscheln*. The translator, who apparently wishes to remain anonymous, has taken all the British species from the original work and added some 89 species not found therein. He has ably translated the general sections of the book and has added much fresh material. Included in these is a most interesting chapter on 'Observations and Researches' and another on 'The Principles of Zoological Classification'. It should be noted, however, that *Neopilina* [p. 12] belongs to a sixth class, the Monoplacophora, and not to the Amphineura.

Parts 4 and 5, dealing with identification, are generally adequate, though the actual descriptions may be somewhat difficult for pupils below the sixth form. Probably owing to the size of the book, the ecological data are minimal. It is felt that the distributional notes could have been more explicit: for instance, 'Dorset' is given for *Theba pisana* [p. 122]—in this fairly large county the only record is a very old one for Muston Down, where the species has not been found since. Also, *Helicigona lapicida* [p. 120] does occur in NW. Yorks. In the main the illustrations are accurate, though the reproduction is not as good as the artist's originals, which the Reviewer has seen. It would appear that Figs. 111 and 112 (*Vitrea*) have been transposed.

This attractive and generally reliable book is one of a series intended for pupils in Secondary schools, and should prove very useful. The Bibliography at the end will help those who wish to carry their studies further. It is a pity that no mention is made either of the Society's Junior Membership or of its Census work, as these would appeal to the Young Specialist.

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J. Conch. **26**: 141–145. (1966)

NOTES ON THE REARING AND BEHAVIOUR IN SOIL OF *MILAX BUDAPESTENSIS* (HAZAY)

J. W. STEPHENSON
Department of Entomology, Rothamsted Experimental Station,
Harpenden, Herts.

(*Read before the Society*, 13 *November* 1965)

This paper summarizes laboratory work done with the slug *Milax budapestensis* (Hazay) as a preliminary to studying its ecology in the potato crop. This slug is a serious pest of potatoes in many districts (BARNES & WEIL, 1945).

Many slugs were needed in experiments and they were reared in the laboratory on a peat-sand-soil substrate (STEPHENSON, 1962). In nature, immature slugs seem to feed on dead organic matter but this could not be used in the cultures because it became mouldy so rapidly. Pieces of carrot root or potato tuber remained mould-free for four to five days, and so these were used instead.

In the cultures, few of the slugs penetrated into the substrate and tests were made with other media of more open texture. Batches of five adult slugs were offered a choice of four soil textures obtained by using soils with particles of different sizes. The soils, which contained little organic matter, were adjusted to a moisture content of 80% and arranged in boxes 12 inch square by 6 inch deep, as shown in Text-fig. 1. Food was withheld during the trial, in which the slugs were released on the soil surface at the centre of each box. The boxes, covered with sheets of perforated polythene, were kept for seven days in an outside insectary where the air temperature fluctuated daily between 5° and 18°C. The position of the buried slugs was recorded when the soil was dug from the boxes after seven days. Text-fig. 1, which summarizes the results of eight trials, shows that the slugs were almost equally divided between the two coarser soils. The finer soils tended to dry and form an unbroken surface which the slugs seemed to find unattractive. The coarser soils dried near the surface but remained moist lower down, and the spaces between the moist particles provided an acceptable slug habitat. A coarse medium was used, therefore, for the culture of these slugs.

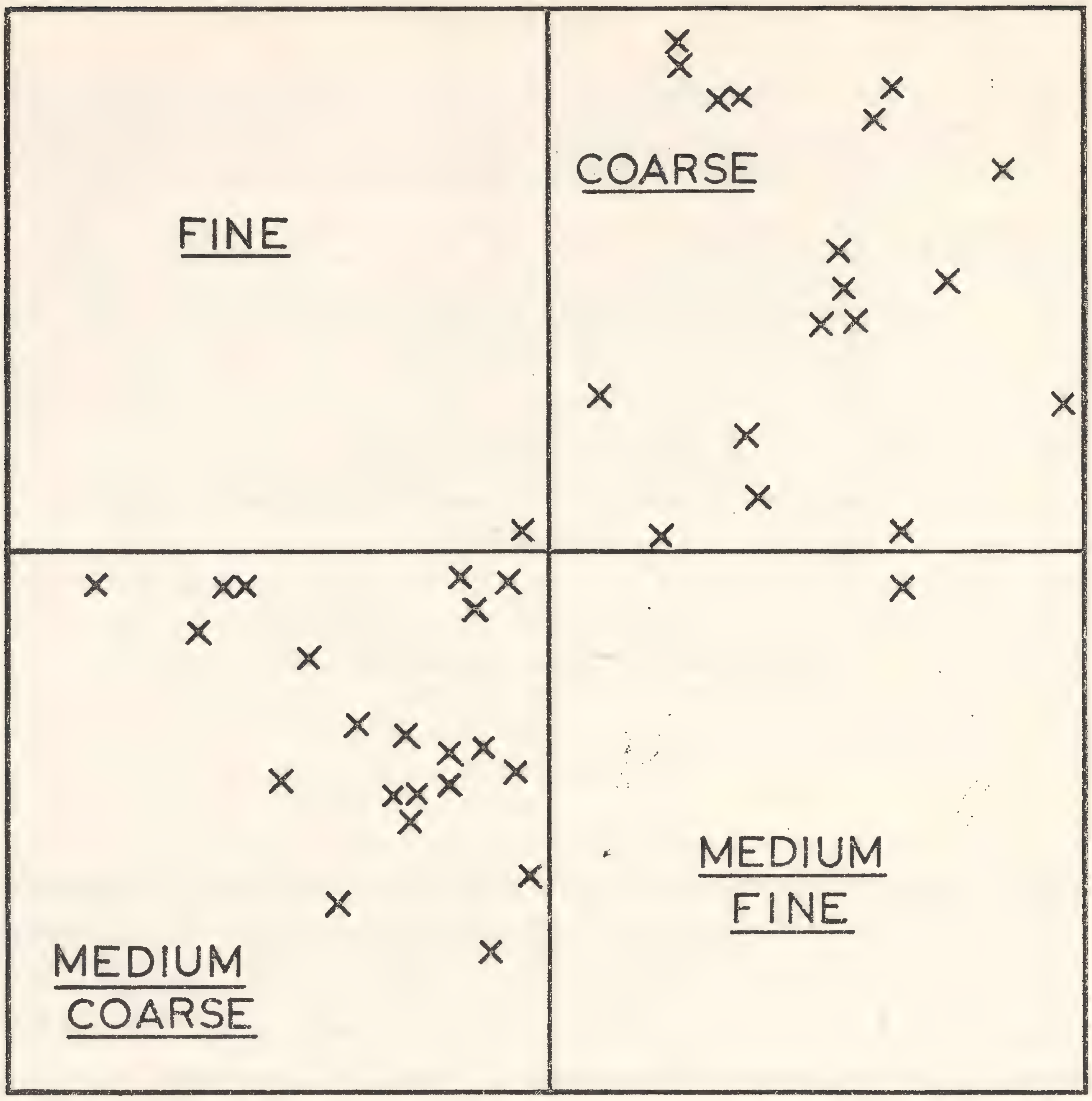

Fig. 1. Distribution of adult *M. budapestensis* in soils of differing textures.

The optimum temperature for development in culture was found by keeping batches of twenty slugs in individual tubes at 5°, 10° and 20°C. The slugs, two to three weeks old at the start of the observations, were weighed every two weeks for nine months. Text-fig. 2 shows the mean growth rate of the twenty slugs at each temperature. Growth at 5°C was extremely slow and was only a little faster at 10°C but rapid at 20°C. Text-fig. 3 shows the considerable difference in growth rate between the fastest and slowest growers from the same egg batch: a similar range was noted in all the cultures. The fastest and slowest growers both lost weight between weeks 20 and 22, and similar losses were recorded at other times. These losses coincided with the appearance of fungus in the cultures, which made the food unpalatable. Even immature slugs survived and recovered from short periods of starvation, however, an ability that obviously favours survival through adverse periods. It means, though, that

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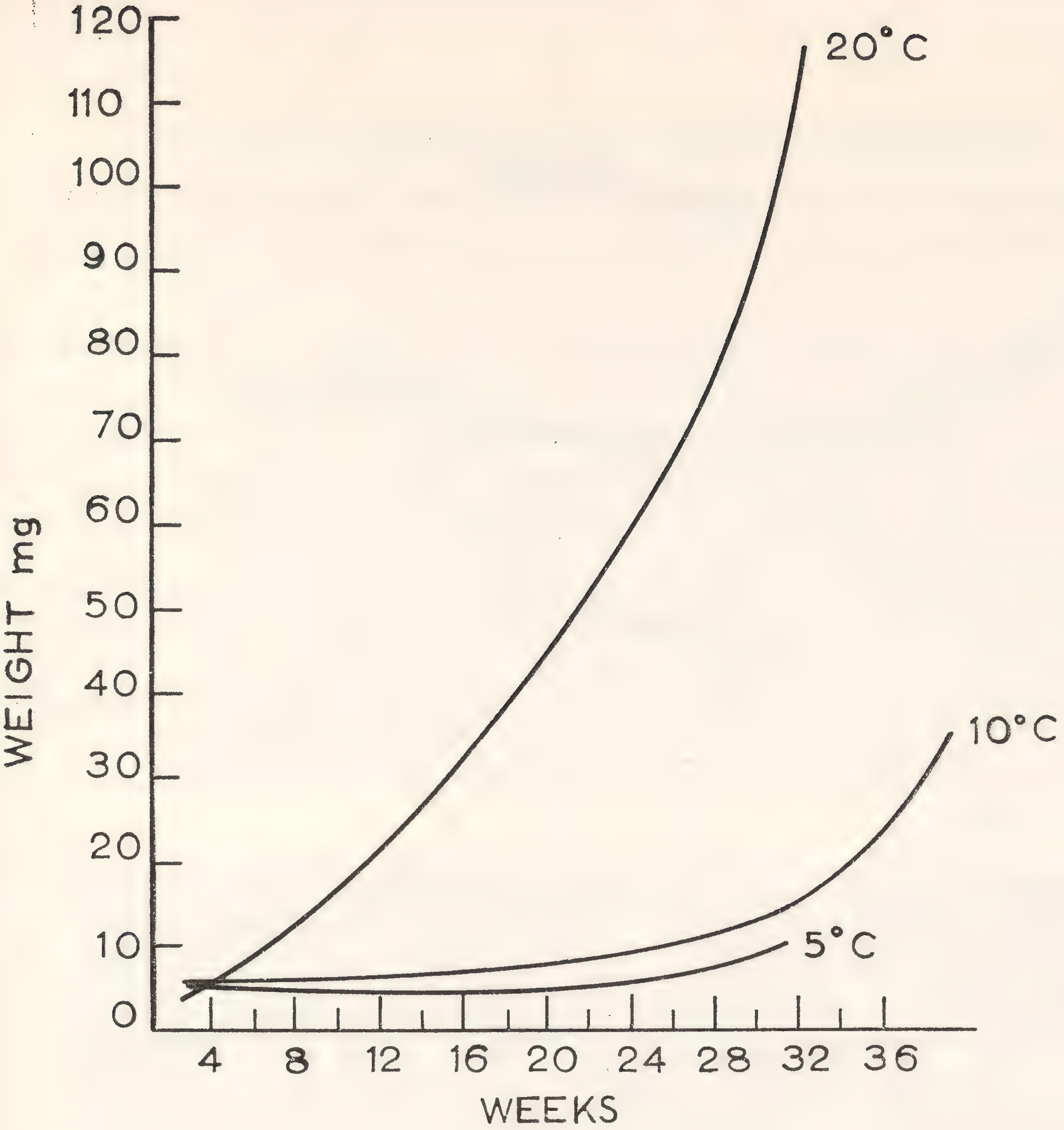
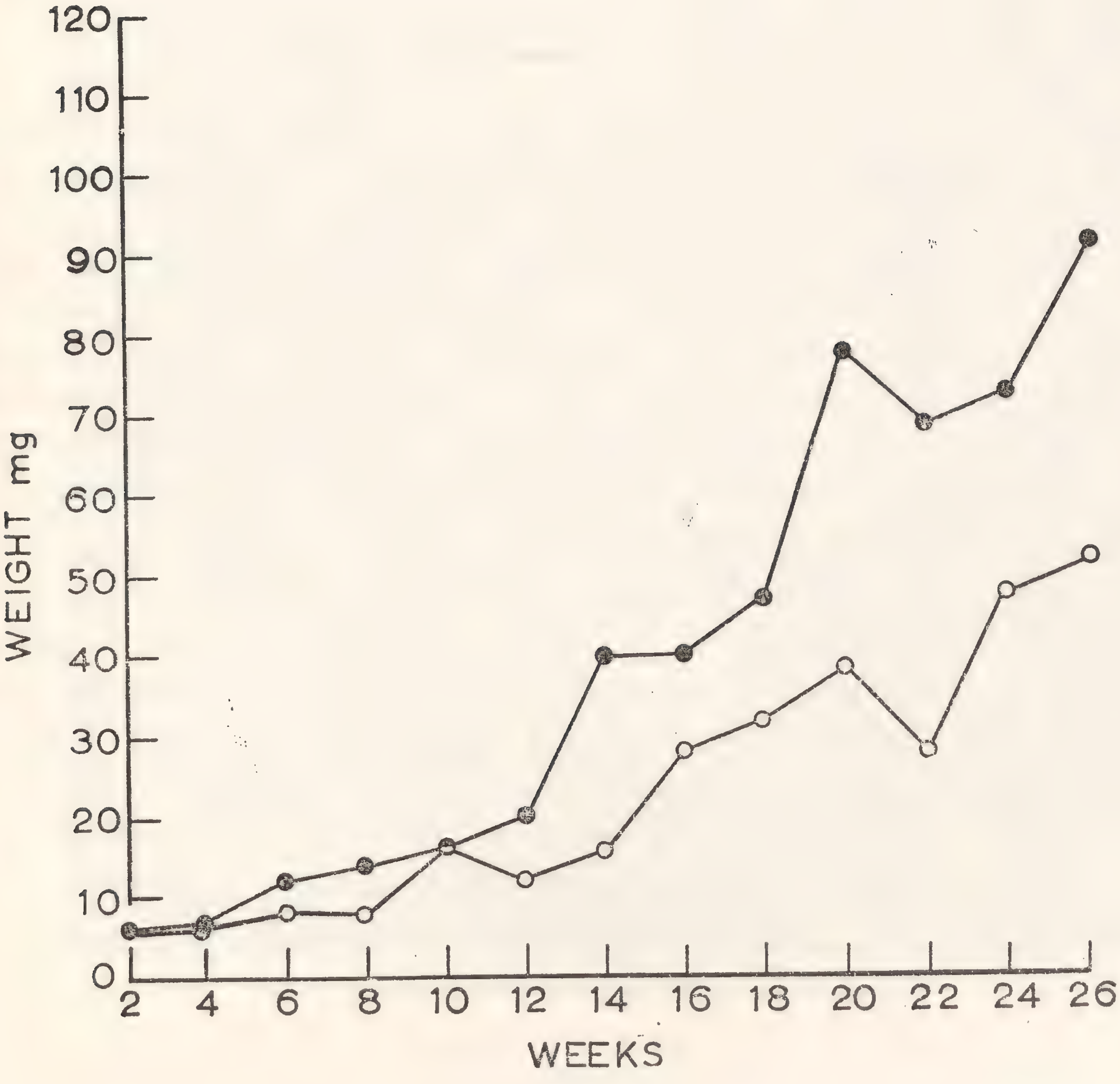
Fig. 2. Mean growth rates of batches of 20 slugs kept at 5°, 10° and 20°C.
Fig. 3. Growth rates at 20°C of the fastest and slowest growers from the same egg batch.



20°C
10°C
5°C
WEIGHT mg
0
10
20
30
40
50
60
70
80
90
100
110
120
4
8
12
16
20
24
28
32
36
WEEKS

Fig. 2.



WEIGHT mg
0
10
20
30
40
50
60
70
80
90
100
110
120
2
4
6
8
10
12
14
16
18
20
22
24
26
WEEKS

Fig. 3.

when selecting slugs at the same stage of development in such work as evaluating potential molluscicides, they must be chosen on the basis of weight rather than age.

Cultures in 5 in by 2 in specimen tubes, each containing one fertilized adult, were kept for more than a year at 20°C but few eggs were laid. Slugs kept at temperatures that fluctuated daily between 10° and 20°C laid more eggs, and the progeny from them were reared successfully. BETT (1960) gave figures for the percentage of mature-mated slugs collected during five half-hour periods per month from December to July. In Text-fig. 4, BETT's data are compared with the percentage of slugs that laid eggs in culture at fluctuating temperatures. Assuming that mature-mated slugs would lay eggs in field soils, Text-fig. 4 shows that the slugs in culture oviposited over almost the same period as those in the field. The technique, therefore, was assumed to be satisfactory for the breeding of this slug.

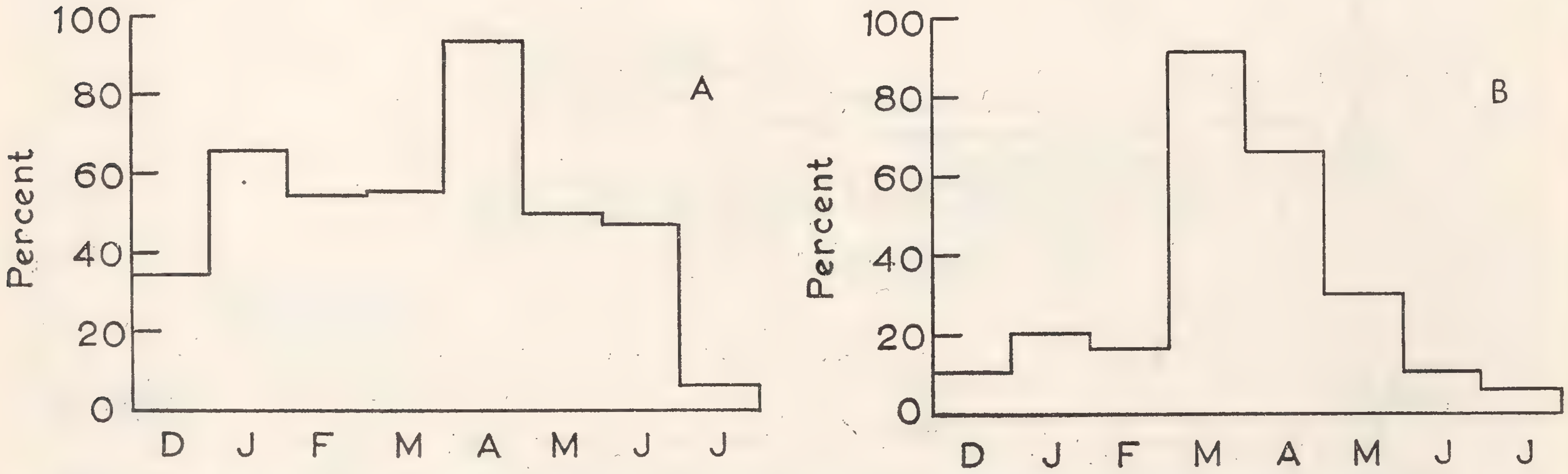
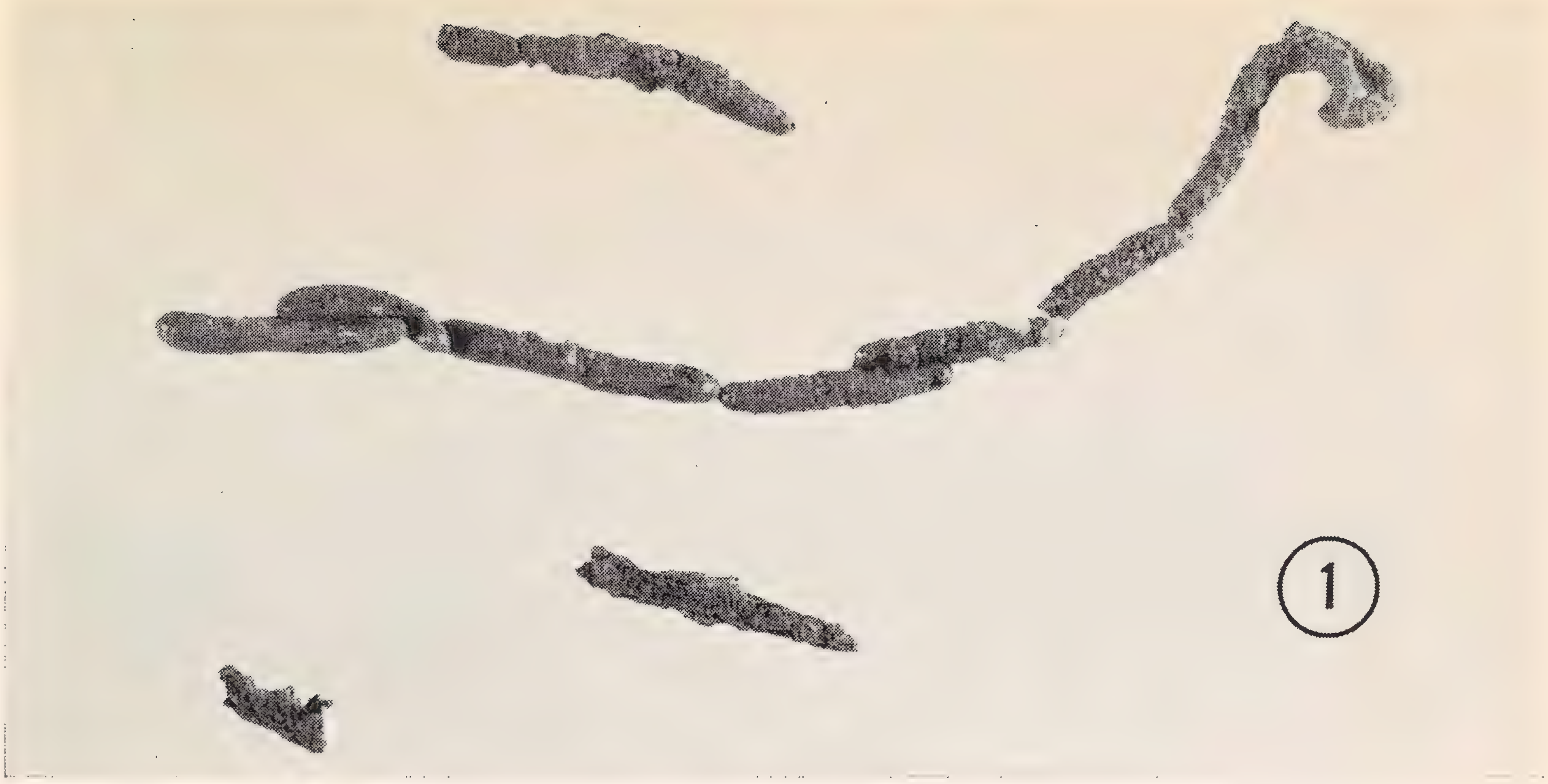


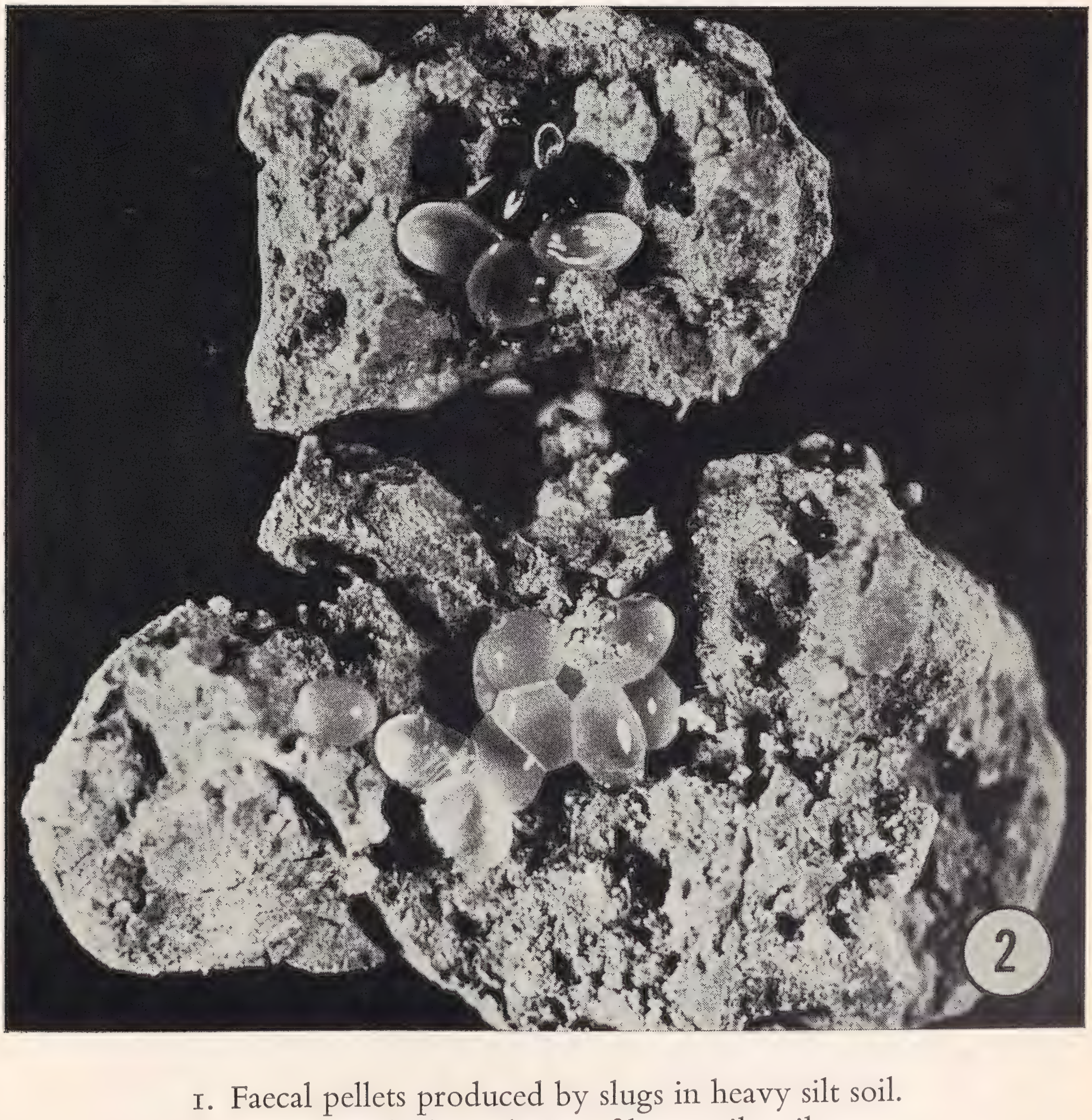
Fig. 4. A Percentage of potential ovipositing slugs from field collections (After BETT), compared with **B** percentage of ovipositing slugs in laboratory cultures.

Holes 4–7 mm in diameter were noticed in a field of medium heavy silt broken down by winter frost. These were the openings of burrows containing *M. budapestensis*, some of which were collected and dissected. Soil was found in the gut contents and sand particles were identified under polarized light. In cultures made from this soil, starved adults moved freely below the soil surface and produced faecal pellets consisting entirely of soil (Pl. 8, fig. 1). Slugs in cultures made from this soil excavated cavities in the hard lumps, in which they deposited their eggs (Pl. 8, fig. 2). In addition, field observations (STEPHENSON, 1963) showed that young slugs could move below the soil surface at depths of up to 37 cm even when there were no cracks. Where there were natural cracks and crevices in the soil, *M. budapestensis* moved up and down in these. Without such cracks, the slugs could burrow by ingesting soil, even on heavy land.

EXPLANATION OF PLATE 8

Figure 1. Faecal pellets produced by starved slugs in cultures made from heavy silt.
Figure 2. A hard lump of heavy silt soil split open to show slug eggs deposited within.





1. Faecal pellets produced by slugs in heavy silt soil.
2. Eggs laid in a lump of heavy silt soil.

SUMMARY

An open textured medium is necessary for the culture of *M. budapestensis*, which can be cultured at 20°C when fed with sliced carrot or potato, and which grows faster at that temperature than at 5° or 10°C. Individuals from the same egg batch grow at very different rates. Egg laying is inhibited by a constant temperature of 20°C and stimulated by fluctuating temperatures. Field and laboratory investigations showed that this slug can burrow through heavy soil by ingesting it. Cavities, in which eggs were laid, can be excavated in hard lumps of soil.

ACKNOWLEDGMENTS

I thank Miss D. J. DAVIES for her help, Mrs R. NYE-BROWN for making the drawings, Mr F. COWLAND for taking the photographs and Dr C. G. JOHNSON for reading the manuscript.

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REVIEW

Seashore Life by Gillian Matthews and Peter Parks. Harmondsworth: Penguin Books Ltd, 1965. pp. 32, with numerous illustrations in the text, many in colour. *Puffin Picture Book* No. 120. Paper covers, stapled. Price 5s.

This little book is primarily intended for those who are beginners in the study of life on the shores of the British Isles. There is an awakening interest in this sphere of our natural history and several publications have recently appeared which help the student, but surely none has attempted to cover so much ground in so short a space. Diversity and brevity are not usually happy stablemates as some items—favourites of the author—tend to get more than their fair share of space, but in this case no fault can be found on that ground.

The book begins with articles on how to set about exploring the shore, where to search and what equipment is needed. The reader is taken to have a look at half a dozen common plants growing on the edge of the shore and cliff, and at fourteen species of seaweed growing between high and low water marks. The animals are largely divided into two categories: those living on a rocky shore, and those inhabiting a more sandy or muddy environment. Fish, crustaceans, molluscs, annelids, echinoderms, tunicates, bryozoans, coelenterates and sponges all have a mention, to a total extent of 121 species. There is a page on maintaining a marine aquarium and articles on egg structures, larval forms, and parasites. The book ends with hints on how to get the most out of observations by the making of notes and records.

At least half the book is occupied by illustrations covering almost every species of plant and animal mentioned in the text. The quality of these figures, many of which are in colour, is first rate at the low price.

Although this small book is, as previously stated, mainly for beginners, there are very few of us who know all that it has to tell and are not able to find a use for it on our shore rambles.

P. K. Earle

Beschreibung
der Naturalien-Sammlung
der Universität zu Rostock
von
Heinrich Friedrich Link
1806–1808

Facsimile Reproduction of the pages relating to Mollusca

Copies of this work, published in 1931 by
J. R. le B. Tomlin and R. Winckworth,
are available from the Hon. Secretary, T. E. Crowley, B.SC.,
The Cottage, Church Street, Bampton, Oxfordshire.

Price: Members—£1, Non-members—£2.

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

824th Meeting, held at the British Museum (Natural History), 16 October 1965

The President, Dr M. P. KERNEY, in the Chair.

Communications

'Radulae of four species of Mitridae (Mollusca: Gastropoda)', by W. O. CERNOHORSKY.

'*Mauritia mauritiana* (Linn.) at Aden', by F. A. SCHILDER.

'Comments on T. E. CROWLEY's paper on *Aspatharia bourguignati* (Bourguignat)', by B. VERDCOURT.

'The genotype of *Marconia* Bourguignat (Streptaxidae): a correction', by B. VERDCOURT.

Exhibits

Special exhibit: *Liguus*, introduced by Mr L. W. STRATTON; examples were also shown by Mrs E. M. CROWLEY and the Revd H. E. J. BIGGS.

Revd H. E. J. BIGGS: unusual specimens of *Mya arenaria* L. from Aldeburgh, Suffolk.

Mr P. E. NEGUS, with help from other Members, mounted a display of fossil Mollusca from the U.S.A.—mostly Miocene fauna from Virginia.

Mr F. M. J. PINN: snails and fossils from Cyprus.

Mr R. P. SCASE: a series of left-handed whelks; a copy of *Hawaiian Shell News* with pictures of the living Golden Cowry *Cypraea aurantium* Gmelin.

825th Meeting, held at the British Museum (Natural History), 13 November 1965

The President, Dr M. P. KERNEY, in the Chair.

Members Elected

BRITISH SUB-AQUA CLUB (Scientific Group, Torbay Branch), c/o K. H. Moncad, M.P.S., D.B.A., 56 Marldon Road, Shiphay, Torquay, Devon.
Mrs M. E. CONWAY, B.SC., 36 Torrington Drive, Potters Bar, Middlesex.
B. P. DENNISON, 8 Almholme Lane, Arksey, Doncaster, Yorkshire.
N. E. ELLIOTT, High Street, Barcombe, Lewes, Sussex.
J. D. R. FRYER, B.SC., F.G.S., Department of Geology, King's College, Strand, London W.C.2.
M. R. HAYES, Police Station, Rabaul, New Britain, New Guinea.
J. F. W. MCOMIE, M.A., D.PHIL., D.SC., 16 Richmond Hill, Clifton, Bristol 8.
W. H. C. RAMSBOTTOM, M.A., PH.D., 'The Croft', Collingham, Wetherby, Yorkshire.
Admiral J. M. REESE, C.B., C.B.E., Wentworth, 11 Links Road, Budleigh Salterton, Devon.
J. F. SINGLETON, 1 Oakwood Gardens, Bathwick Hill, Bath, Somerset.
P. S. SPENCER, 106 Kingsway, Petts Wood, Kent.
J. SUMMERTON, F.R.E.S., F.R.H.S., 81 Leeds Road, Tadcaster, Yorkshire.
S. W. WELCH, 50 Well Road, Otford, Sevenoaks, Kent.
A. O. ZORTEA and Mrs A. E. ZORTEA, Kikwetu Sisal Estate, P.O. Box 1003, Lindi, Tanzania.

Communications

'Revised list of British Mollusca. 1. Introduction—Ostreacea', by J. Bowden and D. Heppell.

'The mitrid genera and species established by P. F. Röding in the "Museum Boltenianum"', by W. O. Cernohorsky.

'Molluscs from a Power Station culvert', by D. S. Davis and W. R. White.

'Kennard's record of fossil *Helix nemoralis* L. in Orkney', by Nora F. McMillan.

Exhibits

Special exhibit: historical specimens, introduced by Mr S. P. Dance who gave a talk on the life of Hugh Cuming, illustrated with books, maps and specimens; Mr D. Heppell exhibited the type-specimen of *Bothrodon pridii* Kerr, now in the Hunterian Collection of Glasgow University, originally described as the poison-fang of 'an extinct serpent of gigantic dimensions' but in reality a labial digitation of *Lambis chiragra* (L.) [see *Newsletter* No. 16]; specimens of Ampullariidae and Placostylidae figured in the *Conchologia Iconica* and other works were displayed by Mr T. Pain; Mr R. P. Scase exhibited some shells from the H.M.S. *Alert* Expedition and some specimens from the Norris Collection auctioned in 1873; Mr L. W. Stratton exhibited specimens of *Helicodonta* collected in 1882 by J. R. le B. Tomlin.

Mr M. R. Block: a large *Vitrina* from Kenya.

Major P. K. Earle: a collection representing about 80% of the species of British marine bivalves.

Mr D. Heppell: preserved specimens of *Pycnodonte cochlear* (Poli), a new British record [see p. 122].

Mrs H. H. E. Nash: shells from Barricane Beach and Shell Island, Woolacombe, Devon.

Mr L. W. Stratton: Shells of *Succinea elegans* Risso from Hertfordshire, its only British locality outside Norfolk; photographs of the *Succinea* bird-fluke; species of *Liarea*.

Mr. W. R. White: photographs of deformed *Mytilus edulis* L. from a power station culvert.

826th (Special General) Meeting, held at the British Museum (Natural History), 11 December 1965

Mr. L. W. Stratton, Vice-President, in the Chair.

Increase in Subscription

The Meeting unanimously approved the increase of the Subscription to £2 per annum, or £40 for life, from 1 January 1966.

827th Meeting, held at the British Museum (Natural History), 11 December 1965

Mr. L. W. Stratton, Vice-President, in the Chair.

Members Elected

Mrs E. Harriman, 32 Leicester Road, Groby, Leicester.
Peter E. P. Norton, B.A., PH.D., Department of Zoology, The University, Glasgow W.2.
I. Peskett, 9 Atlantic Road, Newquay, Cornwall.
A. T. Pollard, St John's College, Cambridge.

Communications

'Notes on two colonies of *Cepaea nemoralis* (L.) polymorphic for white lip', by L. M. Cook.

'Statistics in North-West American *Pusula* Jousseaume (Triviidae)', by F. A. Schilder and M. Schilder.

'Notes on the rearing and behaviour in soil of *Milax budapestensis* (Hazay)', by J. W. Stephenson.

Exhibits

Special exhibit: Streptaxidae, introduced by Dr B. Verdcourt who illustrated his talk with specimens and drawings.

Mr L. S. Atkins: a *Mytilus* and a *Patella* with attached pearls; a well-grown *Mytilus* attached to a shore crab.

Mr T. Dufton: marine Mollusca from Cyprus.

Mr P. E. Negus: fossil nautiloids.

Mr T. Pain: living specimens of *Archachatina* sold for food in Shepherd's Bush market, London.

Mr R. P. Scase: copies of Dillwyn's *Descriptive Catalogue of Recent Shells* and of Wood's *Index Testaceologicus*, to show the connexion between the two works.

828th Meeting, held at the British Museum (Natural History), 22 January 1966

Revd H. E. J. Biggs, Vice-President, in the Chair.

Members Elected

Mrs Elizabeth Barton, 'The Bells', Hemingford Grey, Huntingdonshire.

Melville Servington Lewis, 'Glengarry', 6 Job's Well Road, Johnstown, Carmarthen, South Wales.

B. D. Moreton, b.sc., 'St Johns', Burleigh Road, Charing, Ashford, Kent.

John Moyse, ph.d., Department of Zoology, University College of Swansea, Glamorganshire, South Wales.

National Museum of Canada (Library), Ottawa 4, Ontario, Canada.

Roland H. Raemaekers, 11 rue Isabelle Brant, Antwerp, Belgium.

Communications

'An introduction to the pulmonate family Streptaxidae', by A. C. van Bruggen.

'The species of Mitridae established by J. F. Gmelin in the "Systema Naturae" of 1791', by W. O. Cernohorsky.

'*Agriolimax agrestis* (L.): some observations', by A. E. Ellis.

Exhibits

Special exhibit: brackish-water Mollusca, introduced by Miss J. E. Chatfield who, together with Mr T. Pain, mounted a display of representative species; Revd H. E. J. Biggs exhibited specimens of *Onchidium peronii* Cuvier and *Brachidontes variabilis* (Krauss) from the mangrove swamps of the Persian Gulf; Mr L. W. Stratton exhibited a comprehensive collection of British brackish-water Mollusca.

Mr R. P. Scase: specimens illustrative of the recent paper by Schilder & Schilder (communicated in December), including *Pusula solanderi* (Sowerby) and *P. radians* (Lamarck).

Mr G. N. Smith: a comprehensive collection of Harpidae.

Correction: the exhibit of live Maltese Mollusca in seawater displayed at the 819th Meeting on 16 January 1965 was shown by Mr M. R. Block, not Mr A. Blok as stated on p. 371 of volume 25.

CHANGES OF ADDRESS

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CONTENTS

PAGE

Officers and Council for 1967–68 151

M. P. Kerney—Distribution mapping of land and freshwater Mollusca in the British Isles 152

W. O. Cernohorsky—The species of Mitridae established by J. F. Gmelin in the 'Systema Naturae' of 1791 161

S. P. Dance—*Pisidium* collected by the 1924 Mount Everest Expedition, with descriptions of two new species (Bivalvia: Sphaeriidae) . 175

A. C. van Bruggen—An introduction to the pulmonate family Streptaxidae 181

A. E. Ellis—*Agriolimax agrestis* (L.): some observations . . 189

F. R. Woodward—Monograph of the British Lower Tertiary Unionidae: Corrections and Additions 197

Ernest Dearing—Obituary. J. H. Lumb, 1876–1966 . . . 201

Reviews 202

Accounts for 1965 206

Proceedings: 19 February 1966 (Annual General Meeting) . . 208

Members Elected 212

Changes of Address 214

Plates 9–10

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DISTRIBUTION MAPPING OF LAND AND FRESHWATER MOLLUSCA IN THE BRITISH ISLES

A BRIEF HISTORY AND FUTURE PROSPECTS

M. P. Kerney
Department of Geology, Imperial College, London S.W.7

(*Presidential Address, delivered* 19 *February* 1966)

1. The Past

The foundations of our knowledge of the British land and freshwater Mollusca were laid, as were those of many other aspects of modern science, in the later seventeenth century. In 1678 Martin Lister published, under the *imprimatur* of the Royal Society, his *Historiae Animalium Angliae tres tractatus*, in which he described and figured some thirty-three species which he recognized as occurring in England. As is hardly surprising, his knowledge of geographical distribution was slight; nevertheless, certain passages reveal that he was aware that particular snails had limited ranges. For example, under the species we now know as *Helix pomatia* L. we find (p. 112): 'Agro Hardfordiensi & alibi in Angliâ meridionali abundant, in Septentrionali nusquam mihi saltem occurrit' [in fields in Hertfordshire and elsewhere in southern England; in the north I, at least, nowhere met with it]; and under *Pomatias elegans* (p. 120): 'Per Galliam frequens: at rarior apud nos; in agro tamen Cantiano, & Lincolniensi eam aliquoties inveni: etiam Eboracensis ager eâ non caret' [frequent throughout France, but rarer here; nevertheless, I found them several times in fields in Kent and in Lincolnshire: a field in Yorkshire is also not without them]. Lister goes on to give the exact localities in Lincolnshire and Yorkshire where he had found this species.

Early in the eighteenth century a few naturalists availed themselves of Lister's book to help compile local catalogues. The most notable of these was the work of the Revd John Morton, whose *Natural History of Northampton-shire* (1712) contains a very good account of the snails observed by him in the county during the preceding fifteen or so years. He notes in what sort of places they lived, and which kinds appeared widespread and which rare. Some he recognized as unknown to LISTER.

This early interest did not last. Most eighteenth century works, such as those of PENNANT (1777) and DA COSTA (1778), are essentially compilations, concerned with morphology and taxonomy, and contain little evidence that their authors had looked at Mollusca in the field.

A new era opens with the publication of GEORGE MONTAGU's *Testacea Britannica* (1803 & 1808). In spite of the diffidence expressed by the author concerning the value of his work, it is abundantly clear that MONTAGU had a much better knowledge of land and freshwater Mollusca, especially in their ecological aspects, than any of his contemporaries. As an example of his observation, the following passage dealing with *Helicella virgata* (da Costa) may be quoted (p. 417): 'The *virgata* may be considered as a local species, but is found in prodigious abundance in some sandy, or barren stony situations. Most plentiful near the coast, especially about *Whitsand* bay in *Cornwall*, and in the south of *Devonshire*; . . . It is also found in the more interior counties; is not uncommon in *Wiltshire*; but no where in such abundance as within the influence of saline air'. Although his personal experience was mainly of the south-western counties of England, he saw the need for fuller information on geographical range, and as a contribution appends to his book a 'Catalogue of the shells of North Britain', compiled from the work of LASKEY and BOYS.

MONTAGU's book has certain faults which must have limited its influence. It is awkward to use and only a selection of the species are illustrated. Furthermore, it must have been expensive, and no doubt in its time graced the shelves of many a country house library where the dust was seldom disturbed.

It was not until 1831 that the first popular handbook which could be used for field identification was published. This is the Revd WILLIAM TURTON's *Manual*, a useful little work which probably gave a considerable stimulus to the study of non-marine Mollusca. About this time began again the flow of local lists (e.g. BROWN, 1818; MILLER, 1822; SHEPPARD, 1823; ALDER, 1830; COOPER, 1836; FORBES, 1838), of varying merit but all helping to provide the necessary groundwork on which distribution studies could be based. In 1837 JOSHUA ALDER produced the first critical check-list of species recognized as British, and three years later J. E. GRAY, in his rewritten version of TURTON's *Manual*, had sufficient materials at his disposal to compile what may be regarded as the first census. He lists 128 species (as against the 178 of the Conchological Society's 1951 Census) and shows the geographical range of each—albeit very approximately—by means of a table with numbers for various regions. A blank column is left for the reader's own observations. GRAY realized that snails are often spread by man, obscuring their original distributions, but in an interesting passage he hints that such aliens may sometimes be recognized by their restriction to humanly influenced habitats: 'The facility with which these

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animals migrate and adopt a new country, as proved . . . by the naturalisation of *H. cantiana* [*Monacha cantiana* (Montagu)] on the banks of the Tyne, will always make the study of the geographical distribution of the terrestrial Mollusca difficult. According to the accounts of the American authors, the species which have naturalised themselves retain their fondness for trees and hedges and herbage, and keep themselves quite distinct from the forest-living species of America' (p. 27).

Nevertheless, in spite of the excellence of GRAY's book, which can still be consulted with profit, it seems that a widespread popular interest in the land and freshwater Mollusca did not begin until the second half of the century, about the time of publication of the first volume of JEFFREYS's *British Conchology* (1862). From then until the first world war there appeared a stream of handbooks, such as those of REEVE (1863), TATE (1866), HARTING (1875), RIMMER (1880), ADAMS (1884), WILLIAMS (1888), SWANTON (1906) and HORSLEY (1915). That they met a wide popular demand is clear from the fact that in several cases reprints or new editions were called for. J. W. TAYLOR's *Monograph* began to appear in parts in 1894. Although expensive, the names of about 200 subscribers appear in the first volume. To attempt to explain this interest, which was common to several other branches of natural history, would be a fascinating task but would require a lengthy digression into Victorian social history quite beyond the scope of this address.

The Conchological Society was founded in 1876 and immediately provided a focus. About this time W. D. ROEBUCK systematically began to collect information for what was shortly to become the Society's official Census of non-marine Mollusca (ROEBUCK, 1881, 1921). From the first, progress was very rapid and this must be ascribed not only to ROEBUCK's energy but equally to the existence at this period of so many enthusiastic conchologists, particularly in the north of England. As the basic recording units in England, Wales and Scotland, ROEBUCK adopted the well-known vice-counties devised by the botanist H. C. WATSON between the 1830's and the 1870's (WATSON, 1873). In 1859 C. C. BABINGTON had extended WATSON's system to include Ireland, dividing the country into 37 vice-counties. These ROEBUCK utilized, but for some reason he reversed BABINGTON's numbering, commencing in the north-east with Derry, which he called v.c.113, instead of in the south-west with South Kerry (v.c.113 of BABINGTON). In 1896 PRAEGER increased the number of Irish vice-counties to 40 by splitting Galway and Donegal, and altering BABINGTON's subdivisions for Cork and Kerry. He further suggested that the vice-counties should be numbered from 1 to 40 independently of the British, a proposal adopted by most people concerned with distribution mapping. ROEBUCK, as Recorder of our Society, accepted PRAEGER's new divisions, but unfortunately continued to use his own numbering, which he adapted where necessary by adding suffixes (e.g. 140N and 140S for Galway North-East and South-East). The existence of three separate systems has naturally caused trouble, and to avoid further confusion the Society has recently changed over to PRAEGER's numbering, which is now universally used (*J. Conch.* **25**: 306).

The value of the Society's Census has been very great; one has only to turn to JEFFREYS's *British Conchology* published fourteen years before ROEBUCK began his work to realize how vague and unsatisfactory our knowledge of geographical distribution still was. Under the new scheme records were admitted only if specimens had been seen and authenticated by the Society's referees and, as BOYCOTT put it: 'The uniformity of truth—or error as the case may be—is thus considerable' (in ROEBUCK, 1921). For no other invertebrate group of any size does a comparable British census exist.

If the success of the vice-comital system in Britain was due largely to ROEBUCK, its application to Ireland was primarily the work of PHILLIPS, STELFOX and WELCH. In 1892 R. F. SCHARFF summarized previous records for various parts of Ireland using the twelve 'provinces' into which BABINGTON had grouped his vice-counties. It was evident that much fresh work was needed. This was carried out within the next two decades, R. A. PHILLIPS being responsible for most of the work in central and southern Ireland, and WELCH and STELFOX for recording in the north, north-east, and extreme south-west. In 1911 STELFOX was able to publish a vice-comital census for the country which differs in only minor particulars from that published by the Society in 1951.

The seven editions of the Census, beginning in 1885, are listed by ELLIS (1951). In the earlier, distributions were given in tabular form only, but in 1921 and 1951 there appeared also maps for the various species. Earlier versions of some of these maps were also utilized in TAYLOR's *Monograph* from 1902 onwards. A cheap alternative method of presentation, suggested by PRAEGER (1906) and used effectively by STELFOX (1911) and WOODWARD (1913), but which for some reason never quite caught on, is the 'typomap': the vice-counties are shown by pairs of capital letters set up in type and arranged so that the form of the British Isles is approximately simulated. The divisions in which a species occurs are printed in a heavier type-face, showing the range. The method has the attraction of doing away with the need for expensive blocks. A full account of the idea is given by BALFOUR-BROWNE (1931).

2. THE FUTURE

The application of the vice-comital system has provided information of considerable value. For example, it is clear from the maps in ELLIS (1951) to which biogeographical element certain snails are likely to belong: we can observe that *Geomalacus* and *Hygromia subvirescens* (Bellamy) are Lusitanian, that *Vertigo lilljeborgi* Westerlund and *Acanthinula lamellata* (Jeffreys) are northern, and that *Helix pomatia*, *Helicigona lapicida* (L.) and *Clausilia rolphi* Turton are likely to occur also in central Europe. Something can also be inferred regarding the history of our species. Thus the absence of *Pomatias*, *Azeca*, *Viviparus* and *Unio* from Ireland, like the absence of snakes, suggests that these forms entered the British Isles from the south fairly late in the Post-glacial Period, at a time when the rise in sea-level caused by the melting of the glaciers had already isolated Ireland from Britain, but before the English Channel land-bridge was finally flooded. Geological evidence tells us that this interval occurred, very approximately, between about 7,500 and 5,000 B.C.

But beyond such inferences the vice-comital system has evident limitations. In recent years these have become increasingly obvious because the purpose for which the Census was instituted has been achieved and the flow of new records, except in the case of a few recently segregated species, has almost ceased. Vice-counties have grave disadvantages as recording units. They are large, and have arbitrary shapes and very variable sizes. Easterness (v.c.96), for example, is at least seven times the size of Flint (v.c.51). Single vice-counties can straddle areas differing greatly in climate and geology: the long and narrow Co. Cavan extends from a dry part of Ireland into one of the wettest, and includes a wide variety of rock types. The distributions of all but the most ubiquitous species are much exaggerated. *Azeca goodalli* (Férussac) is shown as having a range similar to that of *Marpessa laminata* (Montagu) although the latter is much the commoner species, occurring in dozens of places in each vice-county while *A. goodalli* might be found in one or two only. Again, many vice-comital boundaries are formed by rivers, and the problem invariably arises as to which division a freshwater species should be referred.

These drawbacks have of course long been recognized and in practice the published maps have not always strictly portrayed distributions on a basis of the vice-counties. In the 1951 Census brackish-water species are shown as thin ribbons along the coasts. Very local forms, such as *Succinea oblonga* Draparnaud, are given as dots representing the actual known localities, and solid black areas are combined with dots in cases where reasonably continuous distributions break up into widely scattered colonies (e.g. *Lauria anglica* (Wood), *Acanthinula lamellata*). Nevertheless, these are compromises, based on insufficient information and leaving much to the discretion of the map-maker.

Apart from the limitations of the basic method, there is a second important reason why a fresh approach to the problems of mapping seems necessary. Distributions are not static, but continually changing in response to climatic shifts and the pressures exerted by human populations. Undoubtedly some species are expanding, others receding. A run of exceptionally mild or unusually severe winters may cause a significant alteration in distribution, particularly where a species is at the edge of its range. Probable instances since about 1900 have been described among plants, butterflies, and wood ants (COLLINGWOOD, 1958; PERRING in JOHNSON & SMITH, 1965; SATCHELL, 1965), and others could no doubt be found among the land and freshwater Mollusca. The importance of human interference hardly needs emphasizing, and some aspects were discussed in my address last year. To discover what changes are in fact taking place, it is obviously first necessary to gain a picture of distribution which is up to date. Yet, as pointed out by CASTELL (1962) in reference to the Mollusca of the London area, the records contained in our present Census represent the results of collecting over a period of nearly a century, and a not inconsiderable number are based on museum material which in some cases is up to 50 years older again.

What is the purpose of a distribution map? What kind of information is to be expected from it? First of all, it should show as accurately as possible where a species is now living. It should be detailed enough to reveal possible correlations between geographical range and factors of physiography, geology and climate (this can conveniently be done by means of transparent overlays). It should also give information on the history of a species in time, and suggest whether it is spreading or retreating. Old records, known extinctions, and Post-glacial fossil finds should be distinguished. If there are areas where a species occurs only in association with human settlements, or is known to have been deliberately introduced, this also should be shown.

In 1950 these problems were discussed at a conference on plant distribution organized by the Botanical Society of the British Isles. The botanists were faced with a situation very similar to our own. Vice-comital floras existed but were singularly unrevealing for many species, particularly of the commoner plants. What could be achieved was demonstrated by the few species for which dot-maps had been constructed, and also by the work being carried out in Holland and Scandinavia, culminating in the publication in 1950 of HULTÉN's magnificent atlas of the flora of northern Europe. Following a proposal by Professor A. R. CLAPHAM it was agreed that a fresh start should be made using as the basic recording unit the 10-kilometre square of the British National Grid, marked on all Ordnance Survey maps (CLAPHAM in LOUSLEY, 1951; WALTERS, 1954). A vigorous publicity campaign was mounted in 1954 and within five years some 1½-million records had been sent in from all parts of the country. To facilitate the handling of this vast mass of information, punched cards and data-processing equipment were used, not only for sorting the records but also for printing the actual distribution maps which form the basis of the splendid *Atlas of the British Flora* (PERRING & WALTERS, 1962).

In 1961 our own Society decided to adopt the 10-kilometre square system. The decision was greatly helped by the interest of Dr F. H. PERRING, director of the Botanical Society's scheme, and by his offer to make available to us the data-processing machinery used in producing the botanical maps.

The basic unit of a 10-kilometre square has proved in practice a workable approximation to the unattainable ideal of plotting every known station for a species. It may be mentioned in passing that a dot-map showing the distribution of *Vertigo alpestris* Alder and *Vertigo pusilla* Müller in north-west England was published in our *Journal* twenty-seven years before the first similar map was constructed for any British plant (DEAN & KENDALL, 1909). Further it is interesting to note that little essential accuracy is lost by transferring the localities shown on this map to the coarser mesh of the 10-kilometre squares, whereas plotting by vice-counties grossly inflates the true ranges of these very local species. A comparison between plotting the distribution of *Abida secale* (Draparnaud) on a basis of vice-counties and of 10-kilometre squares is also revealing (KERNEY, 1962).

The success of the scheme depends entirely on the enthusiasm of our members; the task is indeed formidable but should not be beyond our abilities. First the difficulties. It will be necessary to visit all the 3,500 10-kilometre squares which cover the British Isles and record adequately the species which they contain. Critical groups, such as *Pisidium*, must not be ignored, and doubtful identifications must be carefully checked. Records made before 1950—whether extracted from literature or compiled from old collections—are being kept separate, and if not verified by more recent work will be shown by a different symbol on the final maps. By December 1965, 13,500 new field records had been accumulated, representing an average of about four per 10-kilometre square. It is already clear that the total number of species to be expected in each square will vary enormously in different parts of Britain: some in favourable calcareous areas in the south certainly contain over 100 species, while others in areas of acid moorland or mountain may produce under ten, however carefully they are searched. Nevertheless, a reasonable estimate suggests a final average of about 40 species per square—or about 140,000 in all for the British Isles. It is clear from these figures that progress must be greatly accelerated if the scheme is to be a success, and it would be desirable to obtain at least 10,000 to 15,000 new records a year, as against the present rate of under 4,000. Conchologists, unfortunately, are thin on the ground. The Botanical Society received help from about 1,500 people, whereas only about 60 people have so far sent me records, and most of these were contributed by fewer than 25 active workers. Naturally abilities to identify Mollusca differ widely, and it is part of the Recorder's job to know which identifications on the part of which people need to be backed by voucher specimens!

But the rewards are considerable. The scheme should provide for the first time a picture which is dynamic rather than static. It should reveal not only where snails live, but suggest reasons why they live where they do, and how they came to be there. Correlations will emerge with climate, altitude, vegetation and soil, as well as with the distributions of other plants and animals. A comparison with older records may suggest patterns of change: we may be able to deduce whether a species is expanding, like *Potamopyrgus jenkinsi* (Smith), dying out, like many of our marsh and woodland snails, or merely appearing and disappearing as suitable habitats come and go, like some of the species of *Helicella*. It should be possible to distinguish 'natural' from synanthropic distributions, and we may hope to learn more about the varying status in different parts of Britain of *Helix aspersa* Müller, *Oxychilus draparnaldi* (Beck), *Milax gagates* (Draparnaud) and *Agriolimax caruanae* Pollonera.

If, in say ten years' time, we can produce maps fulfilling these expectations, much of the credit is due to my predecessors as Honorary Recorders of this Society, to whose work I should like to pay tribute. It is to them that we owe our present admirable Census. Without the indispensable control which it provides, the present scheme could hardly hope to succeed.

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THE SPECIES OF MITRIDAE ESTABLISHED BY J. F. GMELIN IN THE 'SYSTEMA NATURAE' OF 1791

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(*Read before the Society*, 22 *January* 1966)

Johann Friedrich Gmelin's account of the Mitridae is contained within the section *Voluta* in the sixth part of the first volume of the thirteenth edition of Linnaeus' *Systema Naturae*, published at Leipzig in 1791. The 144 species of *Voluta* are enumerated on pages 3435 to 3468; fifty-six of these species belong to the family Mitridae, while the remainder are members of such diverse genera as *Columbella*, *Marginella*, *Cancellaria*, *Oliva*, *Voluta* and a host of others.

Gmelin's work on Mollusca occupies a rather unique position among other conchological writings of the time in that it is far from original and appears to be a work in which the descriptions of previous authors are merely repeated. The work is consistently binominal, however, and is the source of a great number of validated non-binominals. In many instances Gmelin's descriptions are verbatim transcriptions from previous works, while in other instances only the Latin syntax has been changed by Gmelin. He cared little about synonymy, even less about locality, and failed to shed further light on dubious species of other authors; it is not unusual to find some of Gmelin's species listed under several specific names.

It is doubtful whether Gmelin was the owner of a private molluscan collection; otherwise he would have made more use, in describing morphological characters, of the specimens before him, instead of describing shells illustrated in previously published figures. It is probable, however, that Gmelin may have seen or borrowed material from the Schröter and Werlich collections.

In the *Voluta* section, 56 specific names are referable to the family Mitridae; 14 of these are Linnaean species, 1 species dates from Born, and the remaining 41 specific names are for the first time validly introduced binominals. Of the 41 Gmelin species, 26 are—or should be—in current use for Recent species, 5 are nomina dubia, 4 qualify as nomina oblita, 2 are species inquirendae, 3 are synonyms, and 1 a homonym of a previously-established species.

GMELIN's work lacked illustrations and, therefore, never became popular with subsequent naturalists or bibliophiles; consequently, numerous species creditable to GMELIN were either completely ignored or else were credited to later authors, particularly LAMARCK. Some of GMELIN's names, which were unequivocally established, have never been repeated since their original descriptions and qualify as forgotten names.

The list which follows is an arrangement of GMELIN's mitrid species in their original sequence. For species established for the first time in GMELIN's work, the original description [in double quotation marks] and citations to illustrations are given and, wherever possible, reference is made to a modern illustration of the species. The currently accepted name and generic position of each species is given in square brackets. The statement 'as of LINNAEUS', etc., indicates that the description and references given by GMELIN correspond closely to those of the original author. An alphabetical list of all the species is given at the end.

Voluta dactylus p. 3443, no. 25 (as of LINNAEUS) [***Pterygia dactylus*** (L., 1767)]

Five references were cited by GMELIN for the typical Linnaean *V. dactylus*; for var. β), GMELIN cited a figure from GUALTIERI (1742: pl. 28, fig. O). This figure resembles *Pterygia crenulata* (Gmelin) or *P. fenestrata* (Lamarck) and was in fact cited by LAMARCK for *P. fenestrata.*

V. paupercula p. 3447, no. 37 (as of LINNAEUS) [***Strigatella paupercula*** (L., 1758)]

GMELIN cited five references to figures for the typical *V. paupercula*; one of these (SCHRÖTER, 1783: pl. 1, fig. 11) was later separated by LAMARCK (1811) as [*Strigatella*] *retusa.* SCHRÖTER (op. cit.: 217) clearly states that his specimens were 'ziemlich stark, und ein schmales weisses Band unterbricht an meinen beiden Beyspielen die braunen Strahlen'; this description clearly represents the species *S. retusa* (Lamarck).

For var. β), GMELIN cited a figure from GUALTIERI (1742: pl. 43, fig. O), which represents an immature specimen of either *Pusia microzonias* (Lamarck, 1811) or *P. consanguinea* (Reeve, 1845). The figure cited for var. γ) (GUALTIERI, 1742: pl. 43, fig. F ?) appears to be a marginellid. For var. δ), two figures from CHEMNITZ were cited (1788: pl. 150, figs. 1417, 1418). These two figures, which do not show the white transverse band clearly, depict a shell with a crenulated outer lip and represent *Strigatella retusa* (Lamarck); the CHEMNITZ figures were actually cited by LAMARCK for his species.

V. nucea p. 3449, no. 43 [***Pterygia nucea*** (Gmelin, 1791)]

"V. testa substriata glabra: spira prominula obtusata laevi, columella quinqueplicata. . . . testa alba productiore tumidula obsolete longitudinaliter striata, spirae anfractibus 5." "GRONOV[IUS]. *Zooph*[*ylacium Gronovianum*]. t. 18. f.11."

GMELIN's description, although fully adequate in conjunction with the cited figure, is only a validation of GRONOVIUS's non-binominal name [ICZN Opinion 261].

The species has an Indo-Pacific distribution, and the locality 'New Zealand' given by several authors (KIENER, 1839; KÜSTER, 1841; REEVE, 1844) is evidently erroneous. For a recent illustration see CERNOHORSKY (1965b: pl. 23, fig. 128).

V. conus p. 3449, no. 140 [***Pterygia conus*** (Gmelin, 1791)]

"V. testa conica alba: basi sulcis transversis excavato-punctatis, anfractibus crenatis, columella sexplicata." No locality. "CHEMN[ITZ]. *Conch*[*ylien-Cabinet*]. **10.** t.150. f.1415, 1416."

The description and cited figures identify the species. This rather rare species has been recorded from Indonesia, the Philippines and the Fiji Islands. The coloured figure in REEVE (1844: pl. 12, sp. 83) is more realistic and better executed than the CHEMNITZ figures; a photocopy of REEVE's figure is given in CERNOHORSKY (1965b: pl. 23, fig. 136).

V. cornicula p. 3449, no. 46 (non L., 1758) [***Mitra schroeteri*** (Link, 1807)]

GMELIN's species is not the *V. cornicula* of LINNAEUS. GMELIN cites two references to figures: one from GUALTIERI (1742: pl. 43, fig. N), which was cited with a query, does not appear to represent a mitrid at all; the other, from SCHRÖTER (1783: 221, pl. 1, fig. 13), is the species later named 'Voluta cornicula schroeteri' by CHEMNITZ (1795: pl. 179, figs. 1733, 1734). CHEMNITZ's names are, of course, non-binominal, and this name was later validated by LINK (1807: 128).

V. scabricula p. 3450, no. 48 (as of LINNAEUS) [***Mitra scabricula*** (L., 1758)]

GMELIN was not familiar with the Linnaean *Buccinum scabriculum* [which he erroneously cites as '*Buccinum scabriusculum*'], as he combined no less than five different species under this name. The only cited figure which actually represents the Linnaean *B. scabriculum* is the illustration in GUALTIERI (1742: pl. 53, fig. D), which was also cited by LINNAEUS (1758); figure 'H' on the same plate, cited by GMELIN with a query, is *Cancilla filaris* (L., 1771). The two CHEMNITZ figures (1780: pl. 149, figs. 1388, 1389) depict *Cancilla praestantissima* (Röding, 1798), and figure 1391 from CHEMNITZ (tom. cit.), referred to by GMELIN with a query, was named some time later *Cancilla circula* (Kiener, 1839).

V. ruffina p. 3450, no. 49 (as of LINNAEUS) [nomen dubium]

GMELIN merely repeated LINNAEUS's description and cited the GUALTIERI figure (1742: pl. 54, fig. G) with a query; the species remains unidentified.

V. nubila p. 3450, no. 143 [***Mitra nubila*** (Gmelin, 1791)]

"V. testa integriuscula laevi lutescente rubro nebulosa transversim striata: labro crenulato, columella quadriplicata." Locality: "in Oceano australi ad insulas amicas" [= Tonga Islands]. "MARTIN [i.e. MARTYN, 1784]. *Univ*[*ersal*] *Conchol*[*ogist*]. 1. t.23."

This species is the same as 'Mitra versicolor' Martyn, 1784 [non-binominal], and *M. versicolor* Lamarck, 1811. Other synonyms are *M. sanguinolenta* Lamarck, 1811, *M. nebulosa* Reeve, 1844 (non Broderip, 1836), *M. propinqua* A. Adams, 1853 (non Sowerby, 1874, nec Garrett, 1880), and *M. erronea* Dohrn, 1861.

The species appears to be restricted to the Pacific region; for a recent illustration see CERNOHORSKY (1965b: pl. 13, figs. 8, 8a).

V. sanguisuga p. 3450, no. 50 (as of LINNAEUS) [***Vexillum sanguisugum*** (L., 1758)]

Ten references to figures have been cited by GMELIN for this well-known Linnaean species.

V. caffra p. 3451, no. 51 (as of LINNAEUS) [***Vexillum caffrum*** (L., 1758)]

GMELIN cited four references for the typical *V. caffra*, and one reference each for var. β) and var. γ); some of the depicted figures look very much like the smooth form of *Vexillum vulpecula* (L.).

V. morio p. 3451, no. 52 (as of LINNAEUS) [nomen dubium]

GMELIN repeated LINNAEUS's description almost verbatim, and omitted to cite references to figures or to shed any further light on the identity of this species.

V. vulpecula p. 3451, no. 54 (as of LINNAEUS) [***Vexillum vulpecula*** (L., 1758)]

GMELIN cited six references to figures for this common and well-known Linnaean species; his reference to MARTYN (1784: pl. 19) for his var. β) is the species 'Mitra tessellata' Martyn [non-binominal], currently known as *Mitra incompta* (Lightfoot, 1786, *ex* Solander MS.).

V. plicaria p. 3452, no. 55 (as of LINNAEUS) [***Vexillum plicarium*** (L., 1758)]

GMELIN listed nine references to figures for this Linnaean species. Figure 'D' on pl. 54 of GUALTIERI (1742) appears to be *Vexillum costellaris* (Lamarck, 1811), while figure 'E' on the same plate looks very much like *V. rugosum* (Gmelin). Two figures from CHEMNITZ cited by GMELIN (CHEMNITZ, 1780: pl. 148, figs. 1364, 1365) also closely resemble *V. rugosum*. For var. β) of *V. plicaria* GMELIN cited CHEMNITZ (1788: pl. 151, figs. 1444, 1445); these two figures are of the species currently known as *Vexillum regina* (Sowerby, 1828), but for further remarks see under *Voluta citrina* Gmelin.

V. crenulata p. 3452, no. 130 [***Pterygia crenulata*** (Gmelin, 1791)]

"V. testa cylindrica decussatim striata impresso punctata alba lutescente nebulosa: labro anfractibusque margine crenulatis nodulosis, columella octoplicata." Locality: "in Oceano indico". "CHEMN[ITZ]. *Conch[ylien-Cabinet]*. **10.** p. 162. t.150. f. 1413, 1414."

The species can be unequivocally identified from the description and cited figures. It has an Indo-Pacific distribution. For a recent illustration see CERNOHORSKY (1965b: pl. 23, fig. 132).

V. scutulata p. 3452, no. 131 [***Strigatella scutulata*** (Gmelin, 1791)]

"V. testa turrita atra alba maculata transversim striata: anfractu primo subventricoso, columella quadriplicata." Locality: "in Oceano indico". "CHEMN[ITZ]. *Conch[ylien-Cabinet]*. **10.** p. 168 t. 151. f. 1428, 1429."

The cited figures depict the species well and the description is fitting; one phrase, however viz 'anfractu primo subventricoso', gives the impression that the first whorl—i.e. the nuclear whorl—is subventricose, whereas the body whorl or last whorl of the shell was probably meant.

The species has an Indo-Pacific distribution; for a recent figure see CERNOHORSKY (1965b: pl. 17, fig. 58).

V. nigra p. 3452, no. 132 [***Mitra nigra*** (Gmelin, 1791)]

"V. testa turrita emarginata nigricante: anfractibus planiusculis, columella quadriplicata.' Locality: "ad Guineae, Indiae, Groenlandiae littora".

GMELIN's use of the name *Voluta nigra* is the first validation of the non-binominal 'V. nigra' Chemnitz, 1788, and 'V. nigra' Schröter, 1788.

The species has an Indo-Pacific distribution, and the indications 'Guineae' and 'Groenlandiae' are most probably erroneous. The only recently published illustration of this species known to the author is in ALLAN (1959: pl. 26, fig. 17); a better figure will be given in CERNOHORSKY's *Marine Shells of the Pacific* (in press).

V. subdivisa p. 3453, no. 133 [***Vexillum subdivisum*** (Gmelin, 1791)]

"V. testa turrita emarginata longitudinaliter costata plicata subtilissime transversim striata, columella triplicata." Locality: "in Oceano indico". "CHEMN[ITZ]. *Conch[ylien-Cabinet]*. **10.** p. 171. t.151. f.1434–1437."

GMELIN's *V. subdivisa* contains two different species. LAMARCK (1811: 206) was the first author to recognize this inclusion of two distinct species under one name, and restricted *Vexillum subdivisum* (Gmelin) to the first two cited figures 1434 and 1435; for the CHEMNITZ figures 1436 and 1437 he provided the new specific name *Mitra costellaris*. A variant with less numerous axial costae was given the name *Mitra nigrina* by LAMARCK (1811: 206). *Mitra lyrata* Lamarck, 1822, is an objective synonym of *Vexillum subdivisum* (Gmelin).

Vexillum subdivisum (Gmelin) has an Indo-Pacific distribution; a recent illustration of this species may be found in CERNOHORSKY (1965b: pl. 20, fig. 92). *V. costellaris* (Lamarck) is also figured on the same plate (loc. cit.: fig. 93).

V. cruentata p. 3453, no. 134 [***Vexillum cruentatum*** (Gmelin, 1791)]

"V. testa turrita emarginata fasciata transversim striata: costis longitudinalibus nodosis sanguineo-maculatis, columella triplicata." Locality: "in Oceano indico". "CHEMN[ITZ]. *Conch[ylien-Cabinet]*. **10.** p. 171. t.151. f.1438, 1439."

The cited CHEMNITZ figures depict an elongate-ovate shell, with the penultimate and body whorl angulate at the shoulder and concave in outline, while the earlier whorls are convexly rounded. The spiral striae are prominently depicted, the axial costae nodulose and blood-red in colour; the body whorl is transversed by two narrow, whitish transverse zones, while a single transverse band almost adjoins sutures on earlier whorls.

This Gmelin species is conspecific with *Mitra harpifera* Lamarck, 1811, which is an objective synonym. The latter name was erroneously spelled '*harpaeformis*' by KIENER (1839), and was misspelled by most subsequent authors. The species has an Indo-Pacific distribution, and has been illustrated by CERNOHORSKY (1965b: pl. 18, fig. 69).

V. exasperata p. 3453, no. 135 [***Vexillum exasperatum*** (Gmelin, 1791)]

"V. testa turrita emarginata granulosa, decussatim striata, longitudinaliter costata fuscescenti fasciata; columella quinqueplicata." Locality: "in Oceano indico". "CHEMN[ITZ]. *Conch[ylien-Cabinet]*. **10.** p. 172. t.151. f.1440, 1441."

var. "β) MART[YN]. *Univ[ersal] Conchol[ogist]*. **1.** t.21."

The CHEMNITZ figures, although not typical of the species, represent the coarse-ribbed variant of *Vexillum exasperatum* of authors. The shell depicted has about 10-11 axial costae on the body whorl and shows the prominent folded callus on the anterior canal—a typical feature of the species. For var. β), GMELIN cited the figure of 'Mitra sphaerulata' of MARTYN (1784), which is an easily recognized species presently known as *Mitra papilio* (Link, 1807).

The species has an Indo-Pacific distribution; a recent illustration of the species will be found in CERNOHORSKY (1965b: pl. 19, figs. 77, 77a, 77b).

V. granosa p. 3453, no. 136 [***Vexillum granosum*** (Gmelin, 1791)]

"V. testa turrita emarginata transversim striata longitudinaliter sulcata, elevato punctata rubescente lineata apice basique nigricante, columella triplicata." Locality: "in Oceano indico". "CHEMN[ITZ]. *Conch[ylien-Cabinet]*. **10.** p. 173. t.151. f.1442, 1443."

The CHEMNITZ figures cited represent the somewhat more obese and smaller variant of the species. Freshly collected specimens from Malaya, Philippines, Australia and Fiji always bear a narrow, whitish, transverse band on all whorls; in occasional specimens, however, the band is extremely faint, and absent in beach specimens. The axial ribs are close-set, the spiral grooves prominent and over-riding the axial ribs, and the shell appears granulose.

The species is sympatric with *Vexillum sanguisugum* in the above-mentioned localities, and they do not appear to intergrade. The species has an Indo-Pacific distribution; for a recent illustration of the species see CERNOHORSKY (1965b: pl. 19, fig. 86).

V. casta p. 3453, no. 137 [***Swainsonia casta*** (Gmelin, 1791)]

"V. testa turrita laevi brunnea albo fasciata: columella sexplicata basi emarginata." Locality: "ad Amboinae littus septentrionale" [Amboina, Indonesia]. "CHEMN[ITZ]. *Conch[ylien-Cabinet]*. **10.** p. 174. vign[ette] 20. f.C, D. MARTYN. *[Universal] Conchol[ogist]*. **1.** f.20."

This species is the 'Mitra fasciata' of MARTYN and CHEMNITZ, and the figures depicted in these two works are a good likeness. GMELIN might have better described the colour-pattern of *Swainsonia casta* as 'white with brown bands' instead of 'brown with white bands'. The broad, brown, transverse band on the body whorl is in fact an 'epidermis' which may be inadvertently removed during cleaning, and which is often partially worn away in large adults.

The species has an Indo-Pacific distribution; for a recent illustration see CERNOHORSKY (1965b: pl. 23, fig. 130).

V. maculosa p. 3453, no. 57 [***Mitra clathrus*** (Gmelin, 1791)]

"V. testa turrita alba: fasciis fuscis reticulatis et maculatis. . . . testa pollicem circiter longa." No locality. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)] t.149. f.1377."

The description is too short, and describes only the colour-pattern of the shell. The CHEMNITZ figure cited is a dorsal view of a shell which bears great affinity to the species *Mitra clathrus* (Gmelin) described on page 3457. *Mitra clathrus* is a very variable species and *M. maculosa* appears to be only one of its forms; the latter should be treated as a nomen oblitum, although it would have page precedence over *M. clathrus.*

The species has an Indo-Pacific distribution; for a recent illustration see CERNOHORSKY (1965b: pl. 14, fig. 25).

V. nodulosa p. 3453, no. 58 [***Mitra nodulosa*** (Gmelin, 1791)]

"V. testa turrita fusca cancellata: sectionum angulis nodulosis albo obumbratis, columella quadriplicata." No locality. "GUALT[IERI]. [*Index*] *test*[*arum conchyliorum*]. t.52. f.F, G. MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.149. f.1385."

var. "β) MARTIN. *Conch.* 4. t.149. f.1390."

GMELIN's *V. nodulosa* is a composite species: the CHEMNITZ figure 1385 is the *Mitra nodulosa* of authors, while figure 1390 is merely a more slender form of the same species. The GUALTIERI figure, however, represents the species *Vexillum crocatum* (Lamarck, 1811).

The radula of the species is unknown; probably it should more correctly be placed in *Vexillum* or *Pusia.* The species lives in the Caribbean region and extends as far as Brazil; for a recent illustration see ABBOTT (1962: 94).

V. spadicea p. 3454, no. 59 [***? Strigatella scutulata*** (Gmelin, 1791)]

"V. testa turrita spadicea luteo nebulosa maculataque: spirae anfractibus octo longitudinaliter plicatis et transverse striatis, columella quinqueplicata." No locality. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.150. f.1392."

The cited delineation from CHEMNITZ is a dorsal view of a shell which could be taken to represent *Strigatella scutulata* (Gmelin). The body whorl is transversely striate near the suture and again towards the base, with the central area smooth. The longitudinal plicae, a feature absent in *S. scutulata* but mentioned in the description, are not discernible in the shell depicted. Although freshly collected specimens of *S. scutulata* are generally dark brown, dead specimens are often bleached to coffee-brown. Most of the description and the figure cited point to *S. scutulata*, but the longitudinal plicae mentioned by GMELIN are incompatible with that species.

V. aurantia p. 3454, no. 60 [***Strigatella aurantia*** (Gmelin, 1791)]

"V. testa turrita aurantia: spirae anfractibus quatuor primis fascia alba, labro denticulato, columella quadriplicata." No locality. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.150. f.1393, 1394."

The species is the *Strigatella aurantia* of authors, and the description is in almost complete agreement with the figures cited, with the exception of the features of the outer lip; the denticulations mentioned in the description are not discernible in the CHEMNITZ figure.

The species occurs from Mauritius to the Philippines, Japan and North Australia; the frequently quoted locality 'New Zealand' is erroneous. No recent illustration of this species is known to the author; it was, however, figured by HANLEY (1856: pl. 20, fig. 120a).

V. decussata p. 3454, no. 61 [nomen dubium]

"V. testa flava turrita decussatim striata: striis longitudinalibus undulatis, columella subquadriplicata." No locality. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.150. f.1395."

The species superficially resembles *Pusia nucleolus* (Lamarck, 1811), but the short description and dorsal view of the species are insufficient for an unequivocal elucidation. *Voluta decussata* may not even be a mitrid species, and could equally well be a columbellid; for this reason it is treated here as a nomen dubium.

V. polygona p. 3454, no. 62 [***Vexillum polygonum*** (Gmelin, 1791)]

"V. testa turrita punctata: anfractibus longitudinaliter costatis et transversim subtiliter striatis: primis tribus angulatis, labro sulcato, columella subumbilicata subquinqueplicata. . . . testa valde elongata et angusta alba fusco nigroque obumbrata, spirae anfractibus 10." No locality. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.150. f.1401, 1402."

This species is the 'Turricula angulosa' of CHEMNITZ, *Mitra aurata* Röding, 1798, *Mitra angulosa* of KÜSTER, 1841, and REEVE, 1844, and *M. fusiformis* Sowerby, 1874 (non Kiener, 1839). The species is fusiformly-elongate, axially ribbed, with the ultimate three whorls concave and angulate at the sutures. The penultimate whorl has two rows of sharp nodules, while the body whorl has two to three rows of nodules upon the axial ribs; one row is situated anterior to the suture, another on the apertural periphery, and the last one towards the base. The basal row of nodules is occasionally obsolete and is not discernible in the specimen figured by CHEMNITZ.

The species inhabits the region between the Philippine Islands and New Caledonia. No recent illustration of this species is known to the author; it was, however, figured by HANLEY (1856: pl. 20, fig. 113a).

V. acuminata p. 3454, no. 63 [species inquirenda]

"V. testa turrita cancellata: cauda brevi cancellata, columella quadriplicata. . . . testa valde elongata lutea vel violacea: fascia nonnunquam alba: apice spirae valde acuto." Locality: "Tranquebariae" [south-east Asia]. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.150. f.1403, 1404."

The cited CHEMNITZ figures depict a shell which is elongate-fusiform, axially closely ribbed and transversely ridged, assuming a latticed appearance. HANLEY (1856) questionably associated *Vexillum crebriliratum* (Reeve, 1844) with GMELIN's species, and KURODA & HABE (1952) consider the two to be conspecific. *V. crebriliratum*, however, is not a latticed shell; the axial ribs are irregular and narrow, and often weakly formed on the ultimate half of the body whorl; the interstices are sculptured with short, deep, spiral grooves and the general appearance of the shell is far from latticed. GMELIN's description and cited figures cannot be associated with any known species with certainty, and about half a dozen Recent *Vexillum* species would partly correspond to GMELIN's diagnosis.

V. turricula p. 3454, no. 65 [***? Vexillum exasperatum*** (Gmelin, 1791)]

"V. testa turrita: columella biplicata, anfractibus turgidiusculis fascia punctorum nigrorum pictis; anfractu primo duplici." No locality. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.149. f. 1376."

The cited figure is a dorsal view of a *Vexillum* species, resembling a small individual of *V. exasperatum* (Gmelin). GMELIN's diagnosis of a two-plaited columella, however, would dissociate it from the Mitridae, unless the specimen he described had the two anterior plicae so weakly developed that their count was ignored.

V. lineata p. 3454, no. 66 [species inquirenda]

"V. testa turrita: lineis perpendicularibus nigris fasciam albam decussantibus, columella subtriplicata. . . . minuta." No locality. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.149. f.1378, 1379."

The CHEMNITZ figures depict a small *Pusia* species which appears to be immature; it resembles immature specimens of *Pusia microzonias* (Lamarck, 1811), although the axial ribs in *P. microzonias* are of the same colour as the remainder of the shell and not black. The species remains unidentified.

V. discors p. 3455, no. 67 [***Strigatella discors*** (Gmelin, 1791)]

"V. testa turrita infra fusca albo-punctata supra alba maculis perpendicularibus virgatis undatis flavis varia. . . . testa minuta, subtus ventricosa; β) magis acuminata, cana: striis ferrugineis longitudinalibus." No locality. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.150. f.1400."; var. β), CHEMNITZ (loc. cit.): fig. 1405.

REEVE (1844) named a *Mitra maculosa* (non Gmelin), which he based on CHEMNITZ's fig. 1400, overlooking GMELIN's prior description of the species. DODGE (1955: 93), placed *Voluta discors* in the synonymy of *Columbella mercatoria* (L.); only GMELIN's var. β appears to be that species, however. HANLEY (1856), DAUTZENBERG & BOUGE (1923), and other writers acknowledge *Strigatella discors* as a valid mitrid species.

The species has a Pacific Ocean distribution. No recent illustration of this species is known to the author; it was, however, figured by HANLEY (1856: pl. 21, fig. 131).

V. sulcata p. 3455, no. 69 [***Pusia microzonias*** (Lamarck, 1811)]

Although this is the earliest name for the species, it is a homonym of *Voluta sulcata* Gmelin, 1791 (: 3436), which is the species *Solidula solidula* (L.).

V. laevigata p. 3455, no. 70 [***Mitra cornicula*** (L., 1758)]

"V. testa turrita laevi fusca: aperturae limbo spiraeque fascia dilutioribus. . . . testa angusta, parva." No locality. "MARTIN. *Conch.* 4 [i.e. CHEMNITZ (1780)]. t.150. f.1408."

This species appears to be synonymous with *Mitra cornicula* (L.).

V. barbadensis p. 3455, no. 74 [***Mitra barbadensis*** (Gmelin, 1791)]

"V. testa turrita rufuscente subtiliter transversim striata: apertura oblongo-ovali, spira obtusata. . . . testa vix 1½ pollicem longa." Locality: "in Oceano americano". "LIST[ER]. [*Synopsis*] *Conch*[*yliorum*]. t.819. f.33."

The species lives in the Caribbean region and extends as far as Brazil. *Mitra striatula* Lamarck, 1811, is an objective synonym of GMELIN's species. For a recent illustration see SHIKAMA (1963: pl. 74, fig. 7).

V. clathrata p. 3455, no. 75 [***Mitra clathrata*** (Gmelin, 1791)]

"V. testa turrita cancellata: spira obtusata, labro marginato, cauda reflexa." Locality: "in Oceano americano". "LIST[ER]. [*Synopsis*] *Conch*[*yliorum*]. t.819. f.34."

The species has a Caribbean distribution. *Mitra clathrata* Reeve, 1844, is a secondary homonym of *M. clathrata* (Gmelin). No recent illustration of this species is known to the author; it was, however, figured by HANLEY (1856: pl. 21, fig. 186a).

V. tricolor p. 3456, no. 76 [***Pusia tricolor*** (Gmelin, 1791)]

"V. testa turrita gibba flava: anfractibus singulis fascia alba nigro tessellata, columella triplicata. . . . testa caudata: spirae apice obtuso." No locality. BUONANNI, 1684 ((3): fig. 37).

The species is variable in sculpture, some specimens being smooth, others axially plicate. The species inhabits the Mediterranean region. For a recent illustration see ARRECGROS (1958: fig. 97).

V. syracusana p. 3456, no. 78 [nomen dubium]

"V. testa turrita laevi alba: maculis virgatis undatis perpendicularibus ex nigro flavis. . . . testa angustiore et magis elongata, quam *turritae* [i.e. no. 77, *V. turrita*]" Locality: "in Syracusano littore". BUONANNI, 1684 ((3): fig. 40).

BORN (1778) cited the BUONANNI (1684) figure for *Strigatella paupercula* (L.), while LINNAEUS (1758) cited the same figure for his *Murex pusio*. There appears to be little justification for associating the BUONANNI figure with *S. paupercula*, as the figure is badly executed and not identifiable with certainty; the figure could possibly be a bad figure of *Mitrella scripta* (L.), as suggested by HANLEY (1855).

V. citrina p. 3456, no. 80 [***Vexillum regina*** (Sowerby, 1828)]

"V. testa turrita citrina, fasciis rufis. . . . testa 2½ pollices longa." No locality. "VALENT[YN]. *Abh*[*andlung*]. **2.** t.2. f.12."

GMELIN's description is very brief, and describes only the colour and size of the species; the cited figure, however, represents without much doubt the species currently known as *Vexillum regina* (Sowerby, 1828). GMELIN's figure citation from a little-known work may be the reason why the specific name *citrina* has been completely ignored by subsequent authors; GMELIN's name for this species is, unfortunately, utterly forgotten and qualifies as a nomen oblitum. *Voluta elegans* Link, 1807, is another prior name of *Vexillum regina*, and is not a nomen oblitum. LINK's name, unfortunately, is a primary homonym of *Voluta elegans* Gmelin, 1791, and *Vexillum regina* must be retained for the species.

V. mucronata p. 3456, no. 81 [nomen dubium]

"V. testa turrita dilute fusca longitudinaliter striata: spira perforata, columella perforata quadriplicata." No locality. "GUALT[IERI]. [*Index*] *test*[*arum conchyliorum*]. t.52. f.M."

The description in conjunction with the cited GUALTIERI figure is insufficient for an unequivocal interpretation of the species, which resembles *Vexillum unifasciatum* (Wood, 1828) and also bears some affinity to *Pusia aureolata* (Reeve, 1844).

V. rugosa p. 3456, no. 82 [***Vexillum rugosum*** (Gmelin, 1791)]

"V. testa turrita subventricosa longitudinaliter rugosa transversim striata exalbida piceo lineata. . . . spirae apice acuto costato, labro marginato." No locality. "GUALT[IERI]. [*Index*] *test*[*arum conchyliorum*]. t.54. f.A."

This is the species which has been known for a considerable time as *Vexillum corrugatum* (Lamarck, 1811); the latter is, however, an objective synonym based on the same recognizable but distorted figure of the species in GUALTIERI (1742).

The species has an Indo-Pacific distribution; for a recent illustration see CERNOHORSKY (1965b: pl. 20, fig. 90).

V. strigosa p. 3456, no. 83 [***Vexillum transpositum*** (Dautzenberg & Bouge, 1923)]

"V. testa turrita cinerea rubro striata: spira glaberrima; anfractibus tumidiusculis." No locality. DEZALLIER D'ARGENVILLE, 1742 (pl. 9, fig. V).

DAUTZENBERG & BOUGE (1923) separated this species from *Vexillum sanguisugum* (L.) under the varietal name *transposita*. DAUTZENBERG (1935) cited the ARGENVILLE figure in the synonymy of *transpositum*. GMELIN's *V. strigosa* is, unfortunately, a nomen oblitum, and DAUTZENBERG & BOUGE's varietal name must be retained. LAMARCK (1811) almost found an answer to the problem when he separated *Vexillum sanguisugum* (L.) from *V. transpositum* (Dautzenberg & Bouge); the former species, however, he called *Mitra stigmataria* Lamarck, 1811, the latter *M. sanguisuga* (L.).

The species has an Indo-Pacific distribution; a recent illustration, under the name '*Vexillum* species', may be found in CERNOHORSKY (1965b: pl. 21, fig. 100).

V. leucosticta p. 3457, no. 85 [nomen dubium]

"V. testa turrita tenui glabra fusca: lineis punctorum alborum cincta." Locality, for var. β) only: "ad insulas amicas" [= Tonga Islands]. "KNORR. *Vergn*[*ügen*]. **2.** t.3. f.7"; var. "β) MART[YN]. *Univ*[*ersal*] *Conch*[*ologist*]. **1.** t.22."

The description is brief and the cited figure does not shed much light as to the identity of the species; the depicted shell is ornamented with ten irregular transverse rows of somewhat tent-shaped small white spots, with four such rows of spots on the penultimate whorl. One could not even suggest what species this figure could resemble. The var. β represents the 'Mitra nexilis' of MARTYN, which is conspecific with *Cancilla filaris* (L.). Besides being a species of uncertain identity, GMELIN's *leucosticta* has disappeared from the literature on the subject, and thus also qualifies as a nomen oblitum.

V. clathrus p. 3457, no. 86 [***Mitra clathrus*** (Gmelin, 1791)]

"V. testa turrita exalbida cancellata: anfractibus fascia macularum flavarum." No locality. "KNORR. *Vergn*[*ügen*]. **3.** t.27. f.3."

Despite the short description, the species can be readily identified from the cited KNORR figure. LAMARCK's *Mitra crenifera* is a synonym of GMELIN's species.

The species has an Indo-Pacific distribution; for a recent illustration see CERNOHORSKY (1965b: pl. 14, fig. 25).

V. virgata p. 3457, no. 87 [nomen dubium]

"V. testa turrita transversim costata, fascia transversa maculisque longitudinalibus undatis fuscis varia. . . . testa crassa 2 pollices longa: apertura alba, costis squamatis." No locality. "KNORR. *Vergn*[*ügen*]. **4.** t.11. f.2."

The cited KNORR figure depicts a shell resembling *Mitra puncticulata* Lamarck, 1811, or *M. ferruginea* Lamarck, 1811. The description, however, does not mention the sutural coronations of *M. puncticulata* and the aperture was described by GMELIN as being white, whereas *M. ferruginea* has a golden-yellow aperture. Since the species cannot be unequivocally identified, it is treated here as a nomen dubium.

V. leucostoma p. 3457, no. 88 [***Mitra papilio*** (Link, 1807)]

"V. testa turrita cancellata spadiceo alboque varia: maculis undatis fuscis, apertura ochroleuca." No locality. "KNORR. *Vergn*[*ügen*]. **4.** t.11. f.3."

It seems unfortunate that GMELIN's name must once again be abandoned as a forgotten name; his description is better than LINK's for *V. papilio*, and a figure is cited which depicts the species well. As early as 1830, MENKE (1830: 85) synonymized *V. leucostoma* with *Mitra scabriuscula* Lamarck, which is the species *M. papilio* (Link).

V. variegata p. 3457, no. 89 [***Scabricola variegata*** (Gmelin, 1791)]

"V. testa turrita transversim striata flava: fascia maculisque fuscis, pluribusque minoribus albis." No locality. "KNORR. *Vergn*[*ügen*]. **5.** t.18. f.6."

The description in conjunction with the good KNORR figure is fully adequate to identify this rather variable species. *Vexillum rufum* Röding, 1798, and *Mitra serpentina* Lamarck, 1811, are synonyms of *M. variegata* (Gmelin).

The species has an Indo-Pacific distribution; a recent illustration of the species may be found in CERNOHORSKY (1965b: pl. 14, fig. 24a).

V. filaris p. 3457, no. 122 [***Cancilla filaris*** (L., 1771)]

GMELIN does not cite a figure, but refers the species to LINNAEUS (1771: 548). For a recent illustration see CERNOHORSKY (1965b: pl. 15, figs. 33, 33a).

V. ziervoyelii p. 3457, no. 127 [***Vexillum (Zierliana) ziervogeli*** (Gmelin, 1791)]

"V. testa ovata badia longitudinaliter rugosa, infra transversim sulcata: spira obtusa ad suturam crenata, columella quadriplicata, labro denticulato." No locality. "CHEMN[ITZ]. *Conch*[*ylien-Cabinet*]. **10.** p. 156. t.149. f.1406."

The cited CHEMNITZ figure is an excellent likeness of this rather distinct *Vexillum* species. GMELIN's erroneous spelling '*ziervoyelii*' was validly emended by DILLWYN (1817) to *V. ziervogeli*, since the species was named for ZIERVOGEL.

The species has been recorded from the Philippine Islands and Japan; for a recent illustration see SHIKAMA (1963: pl. 73, fig. 12).

V. costata p. 3458, no. 90 [***Vexillum costatum*** (Gmelin, 1791)]

"V. testa turrita alba: spira striis subtilissimis transversis costisque rotundatis; anfractu primo fasciis tribus fuscis, columella quadriplicata. . . . cauda subreflexa: striis sex obliquis." Locality: none stated [Viti Levu, Fiji Islands, designated by CERNOHORSKY, 1965b]. "SCHROET[ER]. *Einl*[*eitung*] *in Conch*[*ylien-Kenntnis*]. **1.** p. 302. t.1. f.17."

GMELIN's description is almost a literal translation of SCHRÖTER's (1783) description of the species. The cited figure does not show the long and slender form, fine close-set and rounded axial ribs, and white and orange-brown colouring to advantage. *Mitra subulata* Lamarck, 1811, is an objective synonym of *Vexillum costatum* (Gmelin), while *Voluta ignea* Wood, 1828, is a subjective synonym.

The species has an Indo-Pacific distribution; a recent illustration may be found in CERNOHORSKY (1965b: pl. 18, figs. 72, 72a).

V. spuria p. 3458, no. 91 [***Pterygia dactylus*** (L., 1767)]

"V. testa ovata alba: spira fusco maculata; anfractu primo fasciis sex fuscis, cauda emarginata, labro impresso, columella sexplicata. . . . anfractibus punctis nigris seriatis pictis." No locality. "SCHROET[ER]. *Einl*[*eitung*] *in Conch*[*ylien-Kenntnis*]. **1.** p. 302. t.1. f.16."

Once again we find GMELIN's description to be a verbatim translation from SCHRÖTER. The cited figure depicts a cylindrical and obese shell, with finely-spotted transverse lines and four to five rows of rounded spots. SCHRÖTER (loc. cit.), however, mentions five brown transverse bands on the body whorl, of which the first and fifth bands are interrupted. The figure and description of *V. spuria* seem to correspond only to immature specimens of *Pterygia dactylus* (L.), and to no other species; furthermore, GMELIN's name qualifies as a nomen oblitum.

V. pertusa p. 3458, no. 92 (as of LINNAEUS) [nomen dubium]

GMELIN cited eight figure references for *V. pertusa*, which depict the species *Mitra cardinalis* (Gmelin, 1791), *M. imperialis* Röding, 1798, *M. eremitarum* Röding, 1798, and *M. contracta* Swainson, 1820. It is, therefore, obvious that GMELIN was equally confused about the true identity of *Voluta pertusa* L. as was almost every other author dealing with this species. The author petitioned the ICZN for suppression of *V. pertusa* as a nomen oblitum (CERNOHORSKY, 1965a).

V. cardinalis p. 3458, no. 93 [***Mitra cardinalis*** Gmelin, 1791)]

"V. testa emarginata transversim striata alba; maculis spadiceis utplurimum tessellatis seriatis, columella quinqueplicata. . . . *pertusae* affinis, at testa magis ventricosa et obtusa." Locality: "in Oceano indico". "LIST[ER]. [*Synopsis*] *Conch*[*yliorum*]. t.838. f.65. GUALT[IERI]. [*Index*] *test*[*arum conchyliorum*]. t.53. f.G2. SEB[A]. *Mus*[*eum*]. **3.** t.50. f.50, 51 et t.51. f.6,7. KNORR. *Vergn*[*ügen*].

4. t.28. f.3. v. BORN. *Mus*[*ei*] *Caes*[*arei*] *Vindob*[*onensis*] *test*[*acea*]. t.9. f.11, 12. MARTIN. *Conch.* **4** [i.e. CHEMNITZ (1780)]. t.147. f.1358, 1359."

The species can be unequivocally identified from the description and cited figures. *Mitra monachialis* Röding, 1798, is an objective synonym.

The species has an Indo-Pacific distribution; for a recent illustration see CERNOHORSKY (1965b: pl. 13, fig. 2).

V. episcopalis p. 3459, no. 94 (as of LINNAEUS) [***Mitra mitra*** (L., 1758)]

GMELIN appended no less than eleven references for this well-known Linnaean species.

V. papalis p. 3459, no. 95 (as of LINNAEUS) [***Mitra papalis*** (L., 1758)]

GMELIN cited nine references to figures for the typical *V. papalis*, six references for var. *β*), and one reference each for vars. *γ*) and δ). GMELIN's var. *β*) is the species *V. stictica* Link, 1807; the reference cited for var. *γ*) (SEBA, 1758: pl. 50, figs. 29, 30 ?) is the species *Mitra puncticulata* Lamarck, 1811; var. δ) of *V. papalis* is an indeterminate mitrid species.

V. patriarchalis p. 3460, no. 138 [***Pusia patriarchalis*** (Gmelin, 1791)]

"V. testa obovata solida transversim striata albida croceo et rufescente striata, noduloso plicata; columella quadriplicata, anfractibus tuberculis coronatis." Locality: "in Oceano indico". "CHEMN[ITZ]. *Conch*[*ylien-Cabinet*]. **10**. p. 166. t.150. f.1425, 1426. *β*) CHEMN[ITZ]. *Conch*[*ylien-Cabinet*]. **10**. p. 167. t.150. f.1427."

The cited CHEMNITZ figures depict the *Pusia patriarchalis* of authors and, in conjunction with the description, the species can be unequivocally identified. GMELIN's var. *β*), however, is the species *Pusia bernhardina* (Röding, 1798), better known by its objective synonym *Pusia muriculata* (Lamarck, 1811).

The species has an Indo-Pacific distribution; for a recent illustration see CERNOHORSKY (1965b: pl. 23, fig. 127).

V. filosa p. 3465, no. 111 (as of BORN) [***Cancilla filaris*** (L., 1771)]

The sole reference cited by GMELIN is the illustration in BORN (1780).

ALPHABETICAL SUMMARY OF SPECIES INCLUDED

SPECIES	PAGE	NO.	TAXONOMIC STATUS	CURRENT USAGE
acuminata	3454	63	species inquirenda	
aurantia	3454	60	valid	*Strigatella aurantia* (Gmelin)
barbadensis	3455	74	valid	*Mitra barbadensis* (Gmelin)
caffra	3451	51	Linnaean species	*Vexillum caffrum* (L.)
cardinalis	3458	93	valid	*Mitra cardinalis* (Gmelin)
casta	3453	137	valid	*Swainsonia casta* (Gmelin)
citrina	3456	80	nomen oblitum	*Vexillum regina* (Sowerby)
clathrata	3455	75	valid	*Mitra clathrata* (Gmelin)
clathrus	3457	86	valid	*Mitra clathrus* (Gmelin)
conus	3449	140	valid	*Pterygia conus* (Gmelin)
cornicula	3449	46	synonym	*Mitra schroeteri* (Link)
costata	3458	90	valid	*Vexillum costatum* (Gmelin)
crenulata	3452	130	valid	*Pterygia crenulata* (Gmelin)

SPECIES	PAGE	NO.	TAXONOMIC STATUS	CURRENT USAGE
cruentata	3453	134	valid	*Vexillum cruentatum* (Gmelin)
dactylus	3443	25	Linnaean species	*Pterygia dactylus* (L.)
decussata	3454	61	nomen dubium	
discors	3455	67	valid	*Strigatella discors* (Gmelin)
episcopalis	3459	94	Linnaean species	*Mitra mitra* (L.)
exasperata	3453	135	valid	*Vexillum exasperatum* (Gmelin)
filaris	3457	122	Linnaean species	*Cancilla filaris* (L.)
filosa	3465	111	Born species	*Cancilla filaris* (L.)
granosa	3453	136	valid	*Vexillum granosum* (Gmelin)
laevigata	3455	70	synonym	*Mitra cornicula* (L.)
leucosticta	3457	85	nomen dubium	
leucostoma	3457	88	nomen oblitum	*Mitra papilio* (Link)
lineata	3454	66	species inquirenda	
maculosa	3453	57	nomen oblitum	*Mitra clathrus* (Gmelin)
morio	3451	52	Linnaean species	nomen dubium
mucronata	3456	81	nomen dubium	
nigra	3452	132	valid	*Mitra nigra* (Gmelin)
nodulosa	3453	58	valid	*Mitra nodulosa* (Gmelin)
nubila	3450	143	valid	*Mitra nubila* (Gmelin)
nucea	3449	43	valid	*Pterygia nucea* (Gmelin)
papalis	3459	95	Linnaean species	*Mitra papalis* (L.)
patriarchalis	3460	138	valid	*Pusia patriarchalis* (Gmelin)
paupercula	3447	37	Linnaean species	*Strigatella paupercula* (L.)
pertusa	3458	92	Linnaean species	nomen dubium
plicaria	3452	55	Linnaean species	*Vexillum plicarium* (L.)
polygona	3454	62	valid	*Vexillum polygonum* (Gmelin)
ruffina	3450	49	Linnaean species	nomen dubium
rugosa	3456	82	valid	*Vexillum rugosum* (Gmelin)
sanguisuga	3450	50	Linnaean species	*Vexillum sanguisugum* (L.)
scabricula	3450	48	Linnaean species	*Mitra scabricula* (L.)
scutulata	3452	131	valid	*Strigatella scutulata* (Gmelin)
spadicea	3454	59	synonym	? *Strigatella scutulata* (Gmelin)
spuria	3458	91	synonym	*Pterygia dactylus* (L.)
strigosa	3456	83	nomen oblitum	*Vexillum transpositum* (Dautzenberg & Bouge)
subdivisa	3453	133	valid	*Vexillum subdivisum* (Gmelin)
sulcata	3455	69	homonym	*Pusia microzonias* (Lamarck)
syracusana	3456	78	nomen dubium	
tricolor	3456	76	valid	*Pusia tricolor* (Gmelin)
turricula	3454	65	synonym	? *Vexillum exasperatum* (Gmelin)
variegata	3457	89	valid	*Scabricola variegata* (Gmelin)
virgata	3457	87	nomen dubium	
vulpecula	3451	54	Linnaean species	*Vexillum vulpecula* (L.)
ziervoyelii	3457	127	valid	*Vexillum ziervogeli* (Gmelin)

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J. Conch. **26**: 175–180. (1967)

PISIDIUM COLLECTED BY THE 1924 MOUNT EVEREST EXPEDITION, WITH DESCRIPTIONS OF TWO NEW SPECIES (BIVALVIA: SPHAERIIDAE)

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(*Read before the Society*, 19 *March* 1966)

A contemporary account of the 1924 Mount Everest Expedition (Norton, 1925: 286) stated that molluscs were common up to 15,000 feet in the Himalayas. Among the bivalves collected were several belonging to the genus *Pisidium*; two of the three species represented prove to be new to science.

The specimens were all taken alive in localities at high altitudes, as follows:

Kampa Dzong, Tibet, in a plateau stream at 14,500 feet, 28 iv 1924. *Pisidium (Odhneripisidium) stewarti* Preston. 1 specimen.

Yatung, Sikkim, northern India, under a stone in a stream at 10,000 feet, 3 iv 1924. *Pisidium (Odhneripisidium) kuiper* n. sp. 7 specimens. *Pisidium (Afropisidium) ellisi* n. sp. 1 specimen.

Pisidium (Odhneripisidium) stewarti Preston, 1909

The specimen of this species was sent to J. G. J. Kuiper of Paris for inclusion in a comprehensive report on the species, published recently (Kuiper, 1962b). Kuiper has shown that *P.* (*O.*) *stewarti* should be considered the living representative of *P.* (*O.*) *vincentianum* Woodward—a taxon previously employed for material from Pleistocene and Holocene deposits of western Europe—and that, for purposes of nomenclature, the latter becomes a junior subjective synonym of *P.* (*O.*) *stewarti*.† Dance (1961) has shown that *P.* (*Neopisidium*) *prashadi* Odhner, described from specimens collected at 12,300 feet in Kham Province,

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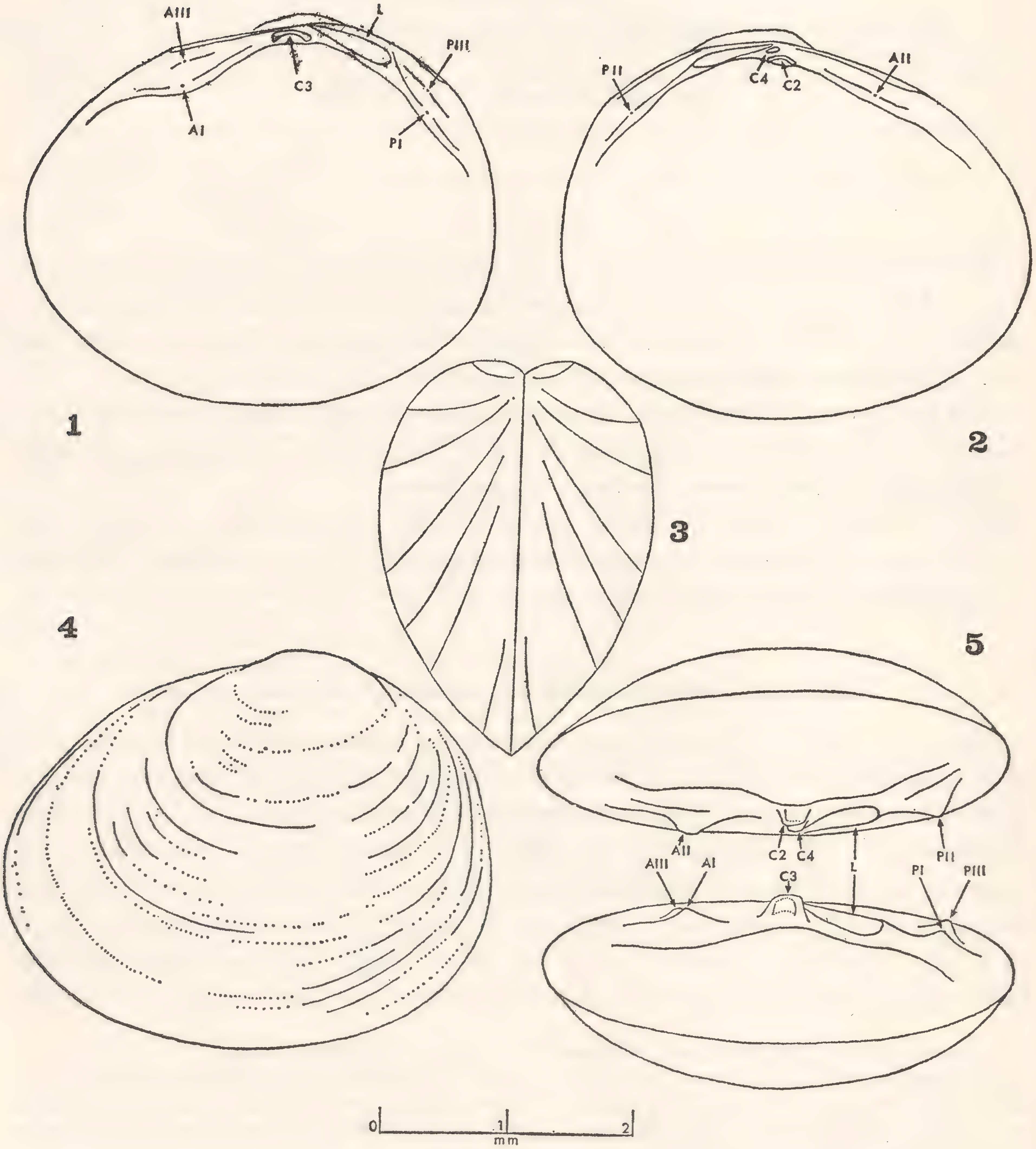
† In 1955 the name *vincentianum* was placed on the Official List of Specific Names in Zoology [ICZN Opinion 336]. It is arguable, therefore, that its senior synonym *stewarti* should not replace it on the basis of date priority alone; the nomenclatural issues involved, however, may have to be re-examined in the light of the more recent taxonomic findings.

Tibet (Odhner, 1937), is also a junior subjective synonym of *P.* (*O.*) *stewarti.* Together with the type-material of *P.* (*O.*) *stewarti*, collected at 14,500 feet in the Gyantse Valley, Tibet (Preston, 1909), the discovery of this specimen at Kampa Dzong constitutes the highest recorded altitude for a living bivalve mollusc.

Pisidium (Odhneripisidium) kuiperi n. sp.

(Figs. 1–5)



Description. Shell inequilateral, rather flattened, thin, semitransparent. Umbones broad, not prominent, almost central. Dorsal margin gently arched, with a steeper slope posteriorly; ventral margin almost straight; anterior produced and well rounded; posterior short and almost straight sided. Periostracum pale yellowish-brown, dull, with fine, irregularly-spaced, concentric striae. Hinge characters: hinge plate moderately solid, not conspicuously narrowed beneath the umbones; lateral teeth well developed, AI, AII, PI and PII long, narrow and pointed, proximal ends of PI and PII passing above the ligament pit; AIII and PIII short, narrow and pointed; C2 long, thin and curved; C4 half the length of C2 and less elevated; C3 slightly longer than C2, curved, thickened posteriorly; C3 nearer to AI and AIII than to PI and PIII, C2 and C4 nearer to AII than to PII; ligament pit long, about $\frac{1}{5}$ length of shell, cutting deeply into the hinge plate and passing under the proximal ends of PI and PII.

The holotype [Reg. No. 196294] and six paratypes [Reg. Nos. 196295/1–6] are deposited in the British Museum (Natural History). Their dimensions (in millimetres) are as follows:

	HOLOTYPE	PARATYPES					
Length	3·7	3·8	3·1	2·9	2·8	2·4	2·2
Height	3·1	3·2	2·5	2·3	2·3	1·9	1·8
Width	2·0	2·2	1·4	1·2	1·2	1·0	1·0

Type-locality. Yatung, Himalaya Mountains, Sikkim, northern India. Found under a stone in a stream at 10,000 feet, 3 iv 1924, Mount Everest Expedition. In association with *Pisidium* (*Afropisidium*) *ellisi* n. sp.

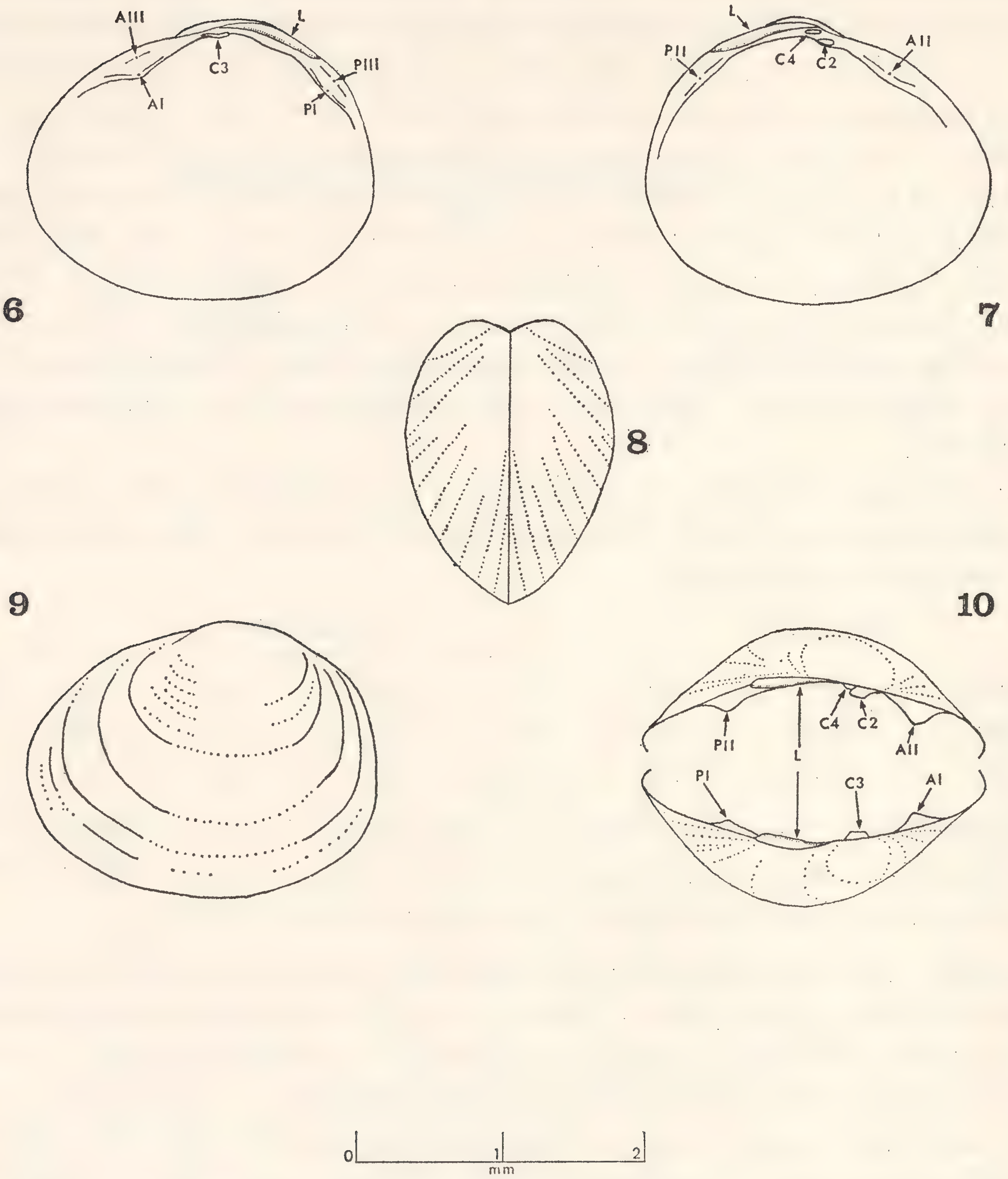
Remarks. The internal ligament pit places this species in the subgenus *Odhneripisidium* (Kuiper, 1962a), but it differs from all the described members of that subgenus by possessing a hinge plate which is not conspicuously narrowed under the ligamental region and by the relatively greater length of the ligament pit ($\frac{1}{5}$ total shell length); and no other member has the proximal ends of PI and PII passing above the ligament pit. It has a less oblique outline than *P.* (*O.*) *stewarti* and *P.* (*O.*) *dancei* Kuiper (Kuiper, 1962b); *P.* (*O.*) *annandalei* Prashad is smaller, more rounded in outline and is regularly striate (Prashad, 1925). A shell illustrated by Prashad (1925: pl. 7, figs. 9, 9a) as *P. atkinsonianum* Theobald, from Gangtok, Sikkim, is certainly not that species and may be *P.* (*O.*) *kuiperi*.

I dedicate this species to J. G. J. Kuiper of Paris, whose extensive knowledge of the genus *Pisidium* has been made available to me at all times.

Figures 1–5. *Pisidium* (*Odhneripisidium*) *kuiperi* n. sp.
1. Holotype, right valve. 2. Holotype, left valve. 3. Paratype [Reg. No. 196295/1], anterior view. 4. Holotype, left valve, exterior. 5. Holotype, ventral view of both valves, showing relative positions of hinge teeth and ligament pit (left valve uppermost).

Pisidium (Afropisidium) ellisi n. sp.

(Figs. 6–10)



Figures 6–10. *Pisidium* (*Afropisidium*) *ellisi* n. sp., holotype.
6. Right valve. **7.** Left valve. **8.** Anterior view. **9.** Exterior. **10.** Dorsal view of both valves, showing relative positions of hinge teeth and ligament pit (left valve uppermost).

Description. Shell inequilateral, moderately inflated, thin, semitransparent. Umbones broad, scarcely visible above inner edge of each open valve. Dorsal margin gently arched, with a slightly steeper slope posteriorly; ventral margin gently curved; anterior slightly more produced and more rounded than the posterior. Periostracum yellowish-brown, glossy, with fine, irregularly-spaced, concentric striae. Hinge characters: hinge plate narrow, especially below the cardinal teeth; lateral teeth moderately well developed, AI, AII, PII long, narrow and pointed; PI, PIII and AIII short and blunt; C2 and C4 thin and straight; C3 twice the length of C2, thin but thickened posteriorly, faintly curved; ligament pit long, about ⅓ length of shell, broad but tapered at both ends, occupying nearly the whole width of the hinge plate at its broadest, bounded below by a slight ridge or fold.

The holotype [Reg. No. 196293] is deposited in the British Museum (Natural History); its dimensions (in millimetres) are as follows:

Length 2·3 Height 1·9 Width 1·2

Type-locality. Yatung, Himalaya Mountains, Sikkim, northern India. Found under a stone in a stream at 10,000 feet, 3 iv 1924, Mount Everest Expedition. In association with *Pisidium* (*Odhneripisidium*) *kuiperi* n. sp.

Remarks. Unfortunately the ligament of the single shell had been lost before my examination, so that its appearance is conjectural. The formation of the ligament pit, however, indicates that the species must be placed in the subgenus *Afropisidium* (KUIPER, 1962a), which was proposed for species having a predominantly external ligament. Viewed from above the dorsal margin (Fig. 10) the position of the ligament pit shows that the ligament must have been clearly visible externally. The slight ridge bounding the ventral edge of the ligament pit is also characteristic of *Afropisidium* as exemplified by its type-species, *P.* (*A.*) *lepus* Kuiper (= *pirothi* Jickeli); and this feature is well seen in *P.* (*A.*) *clarkeanum* Nevill & Nevill, a species widely distributed over the Indian subcontinent. The latter species resembles *P.* (*A.*) *ellisi* superficially, but its lateral teeth are almost equidistant from its cardinals, whereas in *P.* (*A.*) *ellisi* the anterior laterals are much closer to the cardinal teeth than are the posterior laterals [C2 is 0·5 mm from AII, 0·9 mm from PII]. This relationship of cardinal and lateral teeth in *P.* (*A.*) *ellisi* also distinguishes it from the African members of the subgenus, such as *P.* (*A.*) *pirothi*, *P.* (*A.*) *giraudi* Bourguignat, and *P.* (*A*). *fistulosum* Mandahl-Barth; from the Javanese *P.* (*A.*) *javanum* Jutting; from the South American *P.* (*A.*) *sterkianum* Pilsbry; and from the New Zealand *P.* (*A.*) *hodgkini* (Suter).

This species is dedicated to A. E. ELLIS, formerly of Epsom College, Surrey.

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I am indebted to Mr J. G. J. KUIPER of Paris for his critical comments on the material reported here; without his co-operation I should have been unable to present the results of my own study in a satisfactory manner. I am grateful to the Trustees of the British Museum (Natural History) for permission to publish this paper.

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ABBREVIATIONS USED IN FIGS. 1, 2, 5, 6, 7 AND 10

A I, A III	anterior lateral teeth of right valve
A II	anterior lateral tooth of left valve
P I, P III	posterior lateral teeth of right valve
P II	posterior lateral tooth of left valve
C 3	cardinal tooth of right valve
C 2, C 4	cardinal teeth of left valve
L	ligament pit

J. Conch. **26**: 181–188. (1967)

AN INTRODUCTION TO THE PULMONATE FAMILY STREPTAXIDAE

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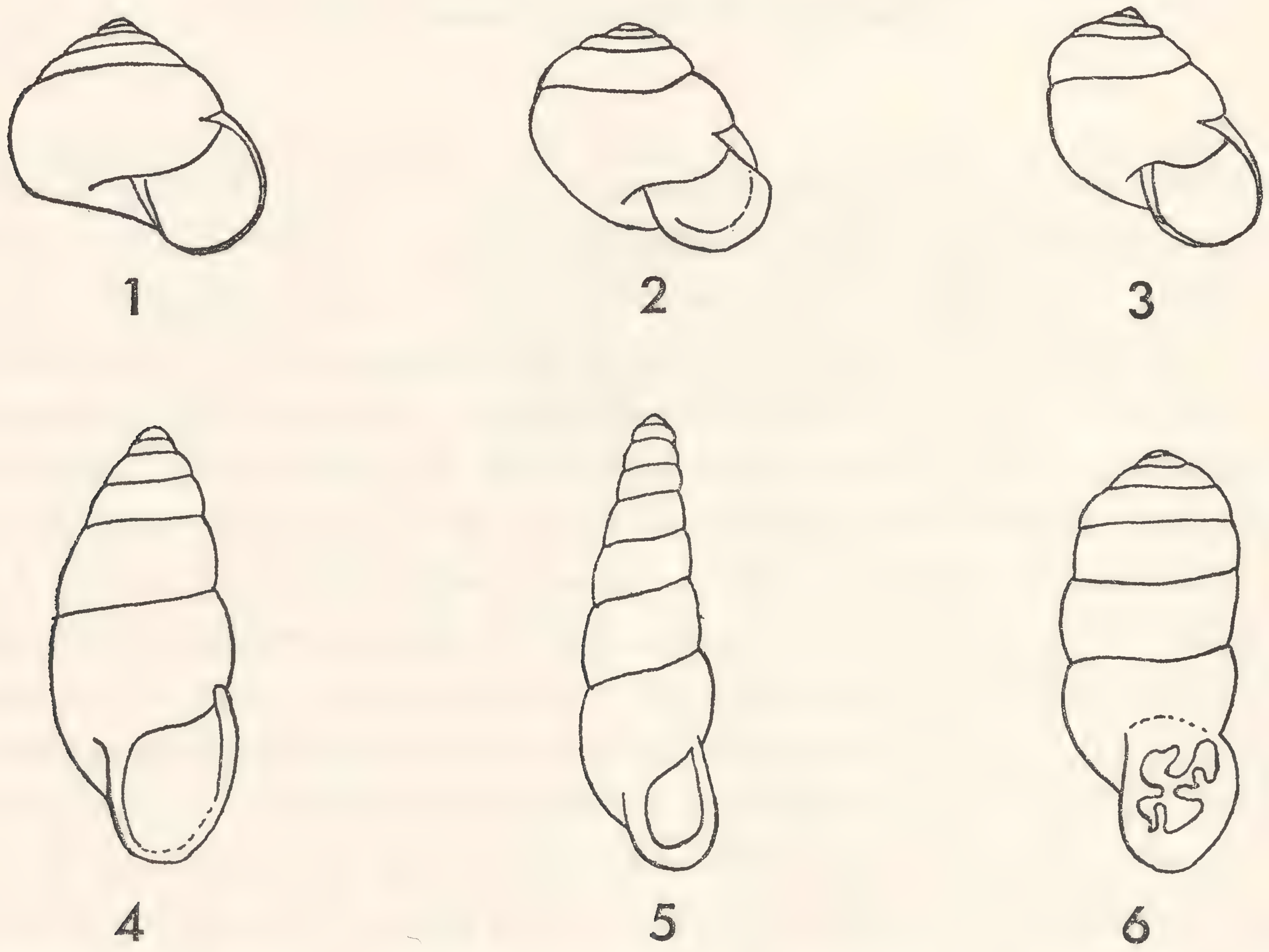
(*Read before the Society*, 22 *January* 1966)

The pulmonate family Streptaxidae belongs to the superfamily Streptaxacea, which is characterized by a simple, undivided foot, a large pharynx, absence of a jaw, a long and narrow radula, comparatively simple genitalia and a carnivorous way of life, reflected in the shape and arrangement of the radula teeth. These characters are shared with the American family Haplotrematidae, the widely-distributed Rhytididae (also known as Paryphantidae: New Zealand, Australia, some Indo-Pacific islands and South Africa) and the specialized South African slug family Aperidae, while the somewhat aberrant South American Systrophiidae have been doubtfully attached to this assemblage of families. Of these, the Rhytididae are probably the most primitive stock from which the Aperidae and Streptaxidae evolved; the position of the Haplotrematidae is not quite clear, but they may in turn be derived directly from the Streptaxidae.

The Streptaxidae are a well-defined family, being characterized by a usually colourless and transparent shell, which does not show much sculpture and sometimes is quite distorted, a long and thin spermathecal duct, a short vagina and a frequently muscular or ensheathed armed penis. Anatomical data are few and far between, but it appears that evolution has taken three courses, resulting in (a) helicoid shells (e.g. *Tayloria*), (b) pupiform shells (e.g. *Gulella*) and (c) turriform shells (e.g. *Streptostele*), although it is difficult to draw the line between the last two categories. The subdivision of the family into Streptaxinae (shell helicoid, frequently asymmetrical, aperture with few or no teeth) and Enneinae (shell pupiform or turriform, aperture with teeth absent, few or numerous) is mainly based on the shape of the shell. Although this is clearly somewhat artificial, it appears that the Enneinae are a fairly natural group which has ceased to exist in South America, only one fossil species being known from that continent [see below].

Shells vary from medium-sized to very small; the largest species are just over 50 mm long (*Edentulina*), but few species grow larger than 30 mm. Sculpture on the shells is limited to growth striae, which may develop into costulae, sometimes even with excrescences (e.g. *Acanthennea*); spiral sculpture is not much in evidence. The majority of the species have some form of dentition in the aperture, varying from a single, poorly-developed parietal and sometimes also an angular lamella to elaborate patterns of denticles and lamellae, which may number up to ten—or even occasionally more—which high figure is usually achieved by subdivision of denticles and lamellae. Although the variety is quite bewildering, these dental patterns are convenient for distinguishing the species, because apertural characters do not seem to be subject to much variation. Various types of streptaxid shells are depicted in Figs. 1–6.



Figs. 1–6. Various types of streptaxid shells. **1.** *Tayloria gigas* (Smith). **2, 3.** *Gonaxis craveni* (Smith). **4.** *Edentulina ovoidea* (Bruguière). **5.** *Streptostele centralis* Pilsbry. **6.** *Gulella rutshuruensis* Pilsbry. All figures schematic. Figs. 1–4 somewhat less than natural size, Figs. 5–6 greatly enlarged. Adapted from Martens (1897), Pilsbry (1919) and Zilch (1960).

There are a number of interesting anatomical features, such as the long and muscular pharynx; the long and narrow radula, sometimes with the central tooth reduced or absent and with long, unicuspid lateral teeth; and simple genitalia without accessory glands etc., although there is sometimes a penial appendage. Exhaustive anatomical data are given by Steenberg (1936); see also Verdcourt (1961) and Berry (1963).

Two modern treatments of the family are available at the generic level, viz those of Thiele (1931) and Zilch (1960). Thiele recognizes eighteen Recent genera, while Zilch lists forty Recent and eight fossil genera. It is difficult to decide which system best fits the needs of modern systematics; Thiele has probably gone too far in synonymizing, while ZILCH may have admitted too many names. The distribution data [see below] are based on ZILCH's system.

The family is widely distributed throughout many of the tropical and subtropical regions of the world: Africa, Madagascar, S. Arabia, the Indian peninsula, Malaya, some of the East Indian islands, the Philippines, Indo-China, China and Japan. Streptaxidae are also very prominent on certain groups of islands in the Indian Ocean, viz the Comoroes, Seychelles and Mascarene Islands. It is quite clear that the Streptaxidae are an essentially tropical family, as only a comparatively small number of species inhabits the subtropics.

The accompanying map [Fig. 7] indicates the area inhabited by the family, together with formulae showing the number of genera (with the number of endemic genera in parentheses) [above the line] and the approximate number of species* [below the line] for certain regions of this area. These data are summarized in Table 1.

The wide distribution indicates that the family is quite old in a geological sense. Its former range has been even larger, as testified by fossils from Europe ranging from the Upper Cretaceous to the Pliocene. The single species of the Canary Islands, *Gibbulinella dealbata* (Webb & Berthelot), represents a genus also known from southern Europe from the Upper Cretaceous to the Upper Eocene. Fossil records from other areas are scanty, amounting to Pleistocene records of still existing genera in East Africa (*Marconia*, *Gulella*) and Mauritius (*Gonidomus*, *Gonospira*), Miocene records of five still existing genera in Kenya (VERDCOURT, 1963), and one extinct enneine genus from the Miocene or Pliocene of Brazil (*Brasilennea*). Isolation has probably been the main reason for profuse speciation such as has occurred in various archipelagos, e.g. the Mascarene Islands with thirty-one endemic species. Undoubtedly the group has been most successful in Africa, where more than 500 species have been described. Compared to this, other areas—such as South America with about eighty-five species, or the Indian peninsula with about sixty—take only a back seat. Attention should also be drawn to the large number of genera in Indo-China (= Further India); this is the second largest number of genera in a restricted area and can be explained by a look at the map, which shows that this area is a meeting place for elements from India, China and Malaya, which is emphasized by the presence of only two (or 20%) endemic genera. The genera that occur in Indo-China have either a general distribution from east to west, or Pakistan to China and Japan (e.g. *Haploptychius*, *Sinoennea*), or only touch Indo-China marginally (e.g. *Perrottetia* in the west, which occurs from the Mascarene Islands and Pakistan to Indo-China; *Elma* in the east, distributed from Tonkin to China).

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* Approximate numbers of species vary from exact data derived from recent literature, via older data which have been inflated to cater for newly-discovered species, to guesses and estimates for poorly-known countries.

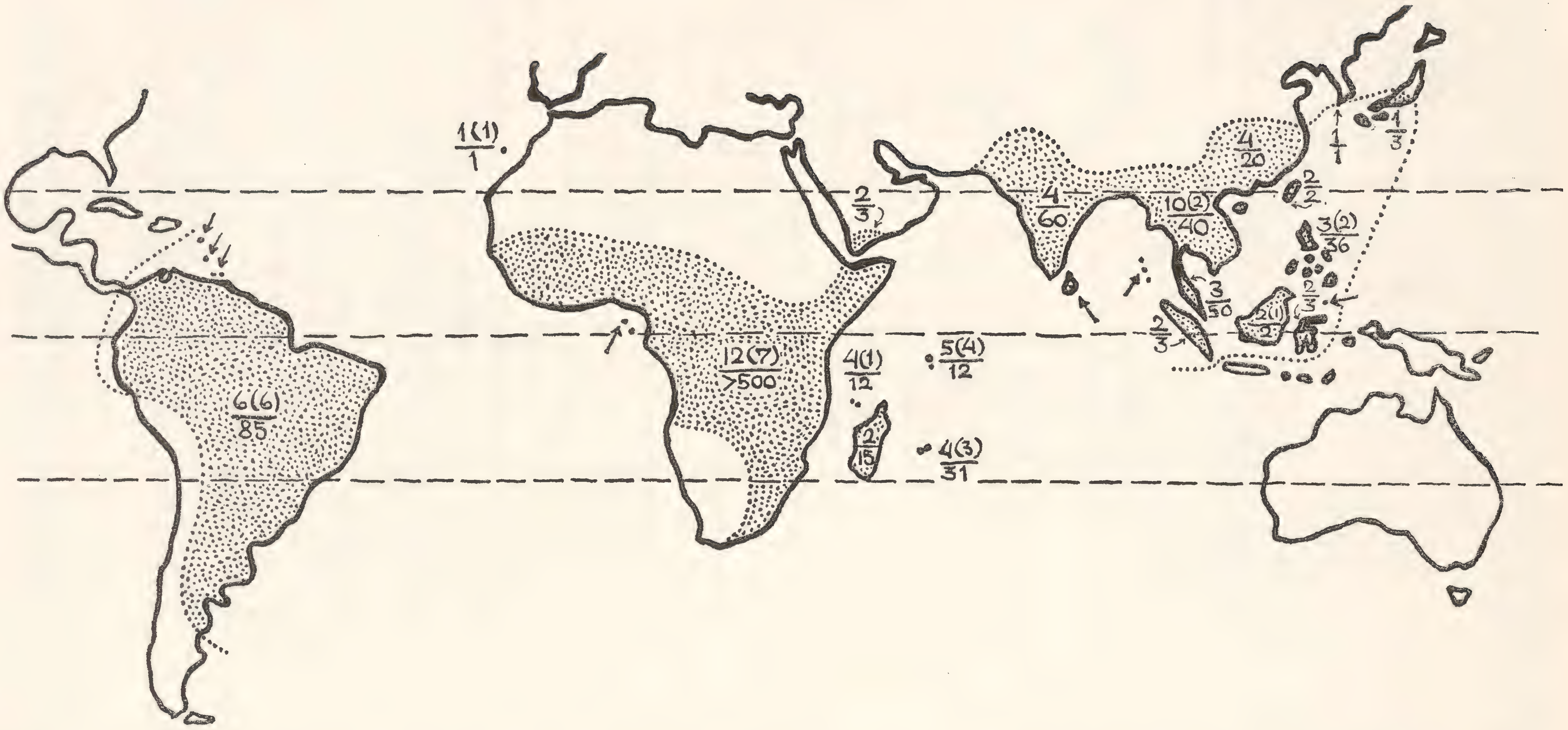

Fig. 7. Distribution of the family Streptaxidae. Arrows indicate islands known to be occupied by the family. The formulae indicate the number of genera (with the number of endemic genera in parentheses) [above the line] and the approximate number of species [below the line].

Certain genera are extremely widely distributed (for Asiatic species see above; in Africa *Edentulina* ranges from Central Africa to the Comoroes, Seychelles and Madagascar, while *Gulella* occupies the whole streptaxid area in Africa and also the Comoroes), while a large number (sixteen, or 40% of the Recent genera) occupy only very limited ranges, mostly on islands in the Indian Ocean, but also in Africa, Argentina, NE. Brazil and Tonkin. At least two continental centres of speciation may be distinguished, viz in Indo-China and in Central and East Africa, where concentrations of numerous genera and species are known to occur. A smaller centre lies in the northern parts of South America. One

Table 1

AREA	TOTAL NUMBER OF GENERA	NUMBER OF ENDEMIC GENERA	APPROXIMATE NUMBER OF SPECIES	SOURCES
Canary Islands	1	1	1	Zilch, 1960
Africa	12	7	500*	Pilsbry, 1919; Connolly, 1939; Verdcourt, 1962, etc.
Madagascar	2	—	15	Fischer-Piette & Bedoucha, 1965
Comoroes	4	1	12	——
Seychelles	5	4	12	Germain, 1921; Connolly, 1925
Mascarene Islands	4	3	31	Germain, 1921†
South Arabia	2	—	3	Connolly, 1941
India, Pakistan, Burma, Ceylon	4	—	60	Blanford & Godwin-Austen, 1908
Malaya	3	—	50	Jutting, 1954, 1961
Indo-China	10	2	40	——
Sumatra	2	—	3	Jutting, 1959
Borneo	2	1	2	Zilch, 1960
Celebes	2	—	3	Solem, 1959
Philippines	3	2	36	Faustino, 1930
China	4	—	20	Yen, 1939
Formosa	2	—	2	Kuroda *in litt.*
Japan	1	—	3	Kuroda *in litt.*
Korea	1	—	1	Kuroda *in litt.*
South America	6	6	85	——

* According to Dr B. Verdcourt (personal communication) 500 is a *very* conservative estimate for Africa.

† Dr E. H. Madge has been working on Mauritian Streptaxidae, and it appears that Germain's book contains many errors.

species has spread throughout the tropics in the wake of Man, viz *Sinoennea bicolor* (Hutton); originally it probably occurred only in parts of India, whence it has spread to Ceylon and further afield as far as Florida, U.S.A. It is a small species which doubtless has travelled in soil, plants, stored products and the like. Many streptaxids are extremely drought-resistant, which may explain survival on long journeys to foreign countries. Unfortunately, streptaxid distribution data are far from complete and much remains to be done in this particular field. At present the author prefers to refrain from speculations in the field of evolution and zoogeography.

Very many species of the family are cryptic in their habits; almost all southern African species live in leaf litter, under stones and logs, in cracks of rocks and under the exposed roots of certain trees (e.g. *Ficus*). They are active only in humid weather, and in semi-arid countries must spend considerable periods in diapause. Although certain species are forest dwellers, very many live outside the shelter of thick forest. In southern Africa a large number of *Gulella* occur in savanna-type surroundings, frequently in broken country with fairly sparse vegetation, open riverine forests, etc., usually in warm or hot climates with a fairly low rainfall. These species are able to survive droughts of from six to twelve months. The small cryptozoic streptaxids are not easy to collect, although they may be quite common; the larger species are much rarer and seldom available in extensive series.

The eggs are comparatively large and few; all juvenile shells are helicoid and only later attain their definitive shape. Dentition develops only in the very last stages of growth. Many juvenile shells are thus unidentifiable unless found together with adults of the same species. In suitable places small streptaxids may be quite common and here one may find a certain number of species together. The body of the live animal is whitish, yellowish, orange or red; usually it is subtransparent and the darker retractor muscles of the tentacles may be seen through the dorsum. The food consists of soft invertebrates; in the laboratory, South African streptaxids refused beef. The only records available to the present author indicate that Subulinidae are frequently eaten; species of this tropical pulmonate family inhabit the same niches as Streptaxidae. Large streptaxid species prey also on Achatinidae—which family is closely allied to the Subulinidae—and on urocyclid slugs. Pupillidae and earthworms are taken too.

Minor variations in aperture dentition do occur, sometimes even frequently, but are almost always easily detected. A certain amount of variation is also met with in the distorted species: a number of *Afristreptaxis elongatus* (Fulton) from Rhodesia, Mozambique and Zululand range from very distorted to almost 'normal' shells [see also Figs. 2–3]. Sinistral shells are extremely rare, only one such case being known to the author (Bruggen, 1963).

The literature on Streptaxidae is profuse, although few papers have been devoted solely to the family. Anatomical literature has been referred to above;

the following local works contain massive data on taxonomy and zoogeography: MARTENS, 1897 (East Africa—rather out of date), BLANFORD & GODWIN-AUSTEN, 1908 (India, Pakistan and neighbouring countries; see also STOLICZKA, 1871), PILSBRY, 1919 (Congo), GERMAIN, 1921 (islands in western Indian Ocean), CONNOLLY, 1939 (southern Africa), JUTTING, 1954, 1961 (Malaya) and VERDCOURT, 1962 (East Africa). Unfortunately, TRYON's treatise (1885) is very much out of date; it enumerates a total of only 276 species and is the only attempt to treat the family on a world basis. ZILCH's paper (1961) contains numerous figures and data on certain Streptaxidae. The list of references below includes all major and some minor works which are indispensable for work on the family.

This introduction to the Streptaxidae does not pretend to be comprehensive. Work on the family is being done in various parts of the world and the present author intends to continue and intensify his studies in the next decade.

The author owes a debt of gratitude to various overseas colleagues for kindly supplying data not available in South Africa.

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AGRIOLIMAX AGRESTIS (L.): SOME OBSERVATIONS

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(*Read before the Society*, 22 *January* 1966)

Introduction

The almost simultaneous receipt of two consignments of the slug *Agriolimax agrestis* (L.)—one from Wheatfen Broad, Surlingham, Norfolk, kindly sent on request in October 1965 by Mr. E. A. Ellis, the other from Harris, Outer Hebrides, collected by Mr J. G. Evans—and also of some putative *A. agrestis* (in reality *A. reticulatus*) collected in South Uist, Outer Hebrides, June 1965, by Mr A. R. Waterston, prompts the following observations on this species and the main differences between it and its congeners, in the hope of inducing students of Mollusca to keep a special look-out for *A. agrestis*, which surely cannot be restricted in the British Isles solely to the Norfolk Broads and the Outer Hebrides!*

History

Over fifty years ago it was shown by Luther (1915) that *Agriolimax agrestis* auctt. really comprises two quite distinct species: for the smaller, unicolorous slug with a simple penial appendage he retained the Linnaean name, *reticulatus* Müller being available for the other, frequently mottled, species with a branched, papillate appendage. The common and ubiquitous 'grey field slug' of the British Isles, hitherto always known as *Limax* or *Agriolimax agrestis*, should be referred to Müller's species, while true *A. agrestis* (L.) was not definitely recognized as British until over 25 years after the publication of Luther's paper (A. E. Ellis, 1941: 238), though its presence in these islands had been suspected a few years previously.

* Addendum: *Agriolimax agrestis* (L.) was collected near Keith, Banffshire, by Mr Edward Kellock, November 1966.

During an investigation of the Mollusca of Wheatfen Broad (now the property of Mr E. A. Ellis), just north of Rockland Broad in the Yare Valley east of Norwich, it was noticed that some of the *Agriolimax* found in reed-swamp and fen were smaller ('more dainty' in Mrs Turk's felicitous phrase), paler, without markings, smoother and more active than the familiar field slug of less moist habitats and gardens. A sample of these slugs was sent to the late Hugh Watson, who pronounced them to be genuine *Agriolimax agrestis* (L.), as opposed to *A. reticulatus* (Müller). Watson wrote: 'These are the first adult British examples of *A. agrestis* (L.) that I have dissected. I have seen what I think are young ones from Scotland, but hitherto all the pale English specimens that I have looked into have proved to belong to the light-coloured variety of the common *A. reticulatus*.' The immature Scottish examples to which Watson referred were from North Uist, Outer Hebrides, collected in 1933 by A. R. Waterston, who is thus the first to discover true *Agriolimax agrestis* (L.) in the British Isles. *A. agrestis* was subsequently recorded from a few other stations in the Broads district of East Norfolk (Sutton Staithe, Alderfen Broad near Irstead, Surlingham Broad) by A. E. Ellis (1949: 388) and again from the Outer Hebrides by Heppell (1961), who found it at Scarista, Harris.

HABITAT

In Norfolk *Agriolimax agrestis* lives, sometimes in considerable numbers, in marshes bordering the Broads, particularly in *Glyceria maxima* swamp and *Juncus subnodulosus* fen, where it particularly congregates on *Angelica sylvestris* and *Peucedanum palustre*, on the umbels of which it feeds, finding shelter by day in the concave leaf-bases of *Angelica* and refuge from flooding at high spring tides on the stems of these tall Umbelliferae (when the slugs are most easily collected). The plant communities of Wheatfen Broad are described by E. A. Ellis (1935), and a summary of the plant communities and an account of the associated Mollusca are given by A. E. Ellis (1941). A more general description of the Norfolk Broads, their geology, botany and natural history, is given by E. A. Ellis (1965); on plate 15 of this book is reproduced (unfortunately upside down) the only photograph I have ever seen of *Agriolimax agrestis* (L.).

At Scarista, Harris [National Grid reference: NG 021939], Heppell (1961) found *A. agrestis* under stones in a roadside ditch, together with the Mollusca *Cochlicopa lubrica* (Müller), *Helicella itala* (L.), *Cochlicella acuta* (Müller), *Arion circumscriptus* Johnston, *Oxychilus cellarius* (Müller), *Retinella nitidula* (Draparnaud) and *Milax gagates* (Draparnaud).

Mr J. G. Evans has kindly supplied the following note on the other Harris station for *A. agrestis*: 'The examples of *Agriolimax agrestis* (L.) were taken in late September 1965 in a field at Northton [National Grid reference: NF 982914]. The locality is a permanently water-logged pasture situated in the low-lying neck of land between the village of Northton and Toe Head. The pasture is grazed by cattle but is too damp to be cultivated. Crossing the pasture is a number of causeways, one to two feet high and built of earth and loose stones. It was under some of these stones at the base of one of the causeways that the examples of *Agriolimax agrestis* were found. Mollusca found in the same habitat were *Carychium minimum* Müller, *Succinea pfeifferi* Rossmässler, *Arion intermedius* Normand, *Retinella radiatula* (Alder), *Vitrina pellucida* (Müller), *Agriolimax reticulatus* (Müller) and *Pisidium personatum* Malm.' Mr EVANS adds that 'it is interesting to note that WALDÉN (1955: 418) finds *A. agrestis* (L.) especially on margins of lakes and rivers, open fields, in ditches and gardens.'

It thus appears that in its few known British localities *A. agrestis* (L.) favours wet or marshy habitats, except for HEPPELL's station at Scarista. On the continent of Europe, where so far as is known its distribution is mainly northerly, it is not restricted to damp places.

DISTINCTIVE CHARACTERS

The following description is taken from QUICK (1949: 26): '*Agriolimax agrestis* is about 3·5 cm long with a short, obliquely truncated keel. The body and mantle are pale buff in colour without darker spots or splashes, or with only very little. The respiratory orifice has a paler rim. The mucus is milky from the presence of lime particles, especially when the animal is irritated, and it is perhaps more active than its ally. It differs from *reticulatus* in being slightly smaller, with rather less distinct tuberculation, and in its more uniform colour. Internally the main differences are in the short penial appendage, which is undivided, the more anterior position of the ovo-testis, and in the shell, which is a little smaller, viz 3 mm long, with a slightly concave right border.' This description is based on Norfolk specimens, but those from Harris are similar. The internal anatomy is figured by QUICK (1960: Figs. 10 and 11).

The most definite diagnostic character of *A. agrestis* is the shape of the penial appendage, which is quite easy to find and examine. When the body cavity is laid open by a median dorsal incision (or as some prefer along the left side), the penis is conspicuous at the front end on the right of the buccal bulb. It is a rather solid organ, about 4 mm long (up to 8 mm in *A. reticulatus*), in shape rather like a slightly twisted groundnut containing two kernels. The fore portion contains the hollow, conical stimulator or sarcobelum, which is an invagination of the right side of the sac; the hinder part, near the apex of which the vas deferens enters, is the actual copulatory organ. At the free hind end is the penial appendage, which in *A. agrestis* is a simple, finger- or thumb-like organ, unbranched and devoid of papillae [Figs. 1–2]. In contrast, the claw-like penial appendage of *A. reticulatus* has normally three papillate or crenulate branches of unequal length, suggesting a cock's comb, but is so exceedingly variable that no

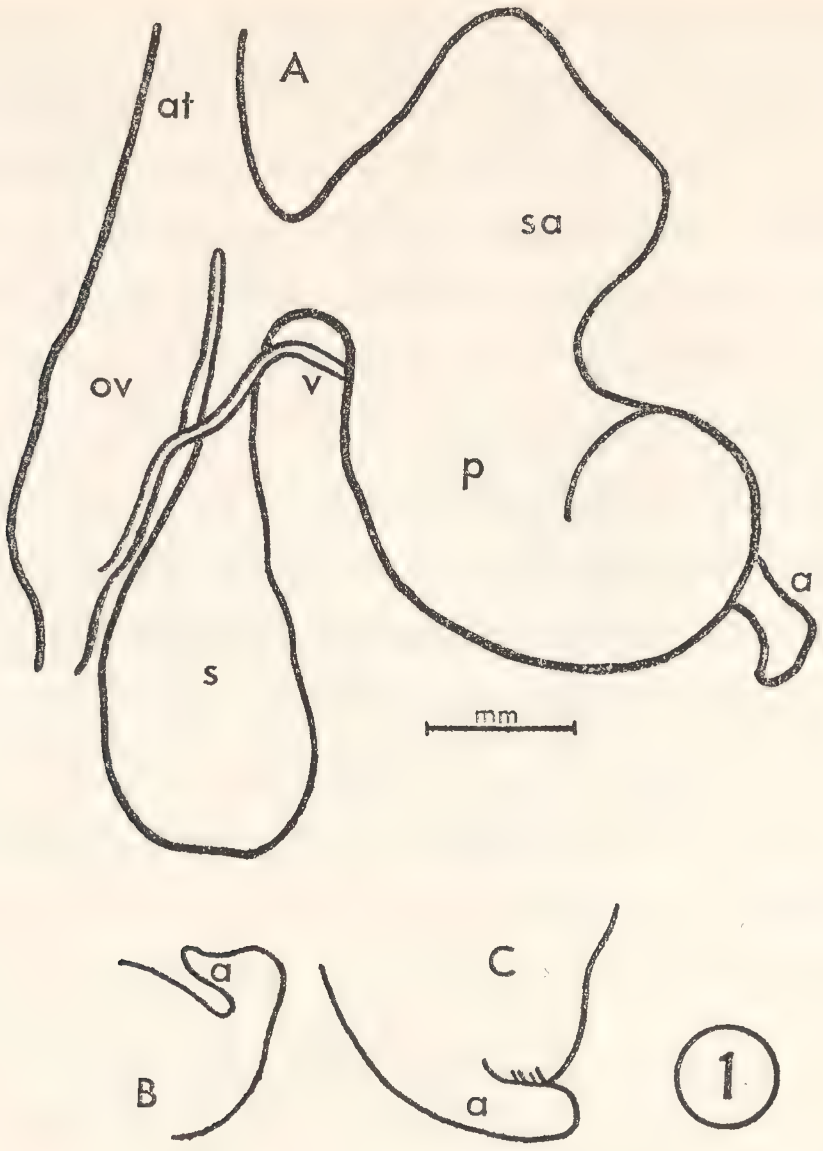


Fig. 1. *Agriolimax agrestis* (L.), Northton, S. Harris, J. G. Evans. **A**. Distal (anterior) genitalia. **B, C**. Penial appendage of two other specimens. *a* penial appendage, *at* genital atrium or vestibule, *ov* oviduct, *p* penis, *s* spermatheca, *sa* sarcobelum sac, *v* vas deferens or sperm duct.

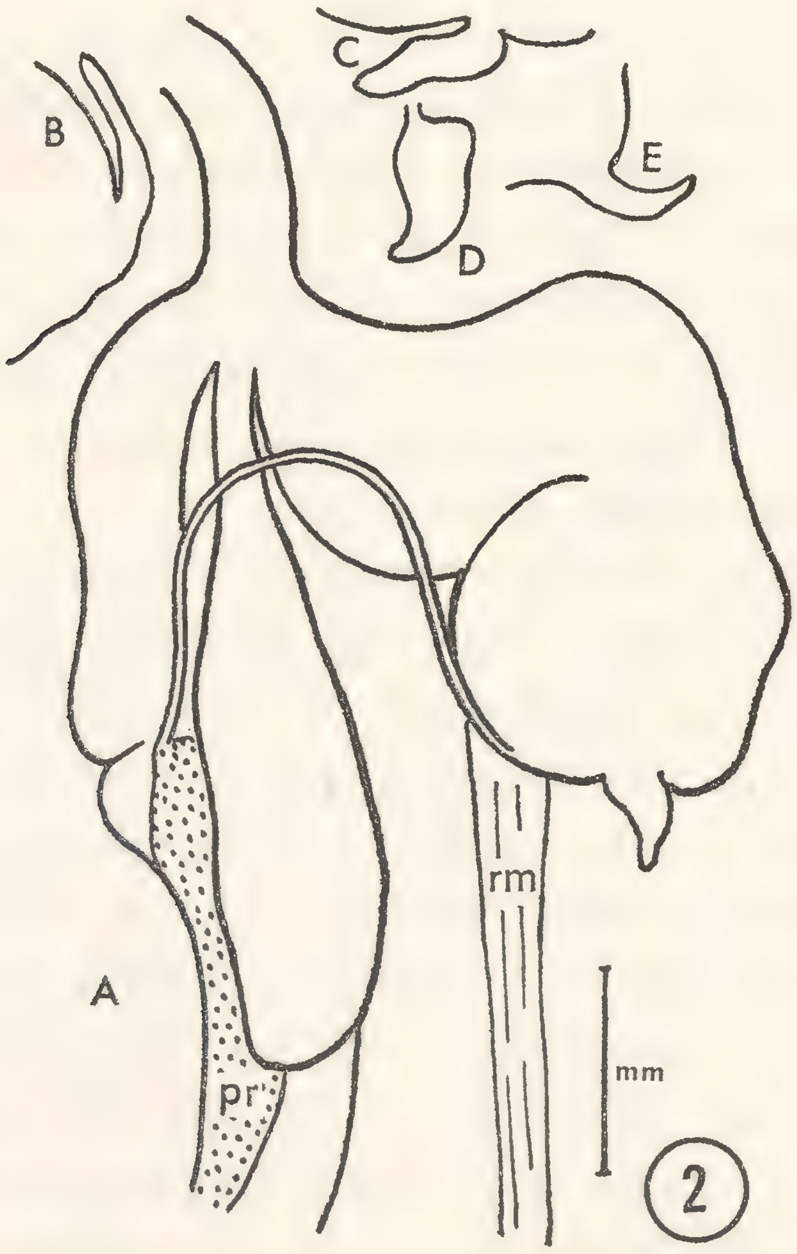


Fig. 2. *Agriolimax agrestis* (L.), Wheatfen Broad, Surlingham, E. Norfolk, E. A. Ellis. **A**. Distal genitalia. **B–E**. Penial appendage of four other specimens. *pr* prostate, *rm* retractor penis muscle.

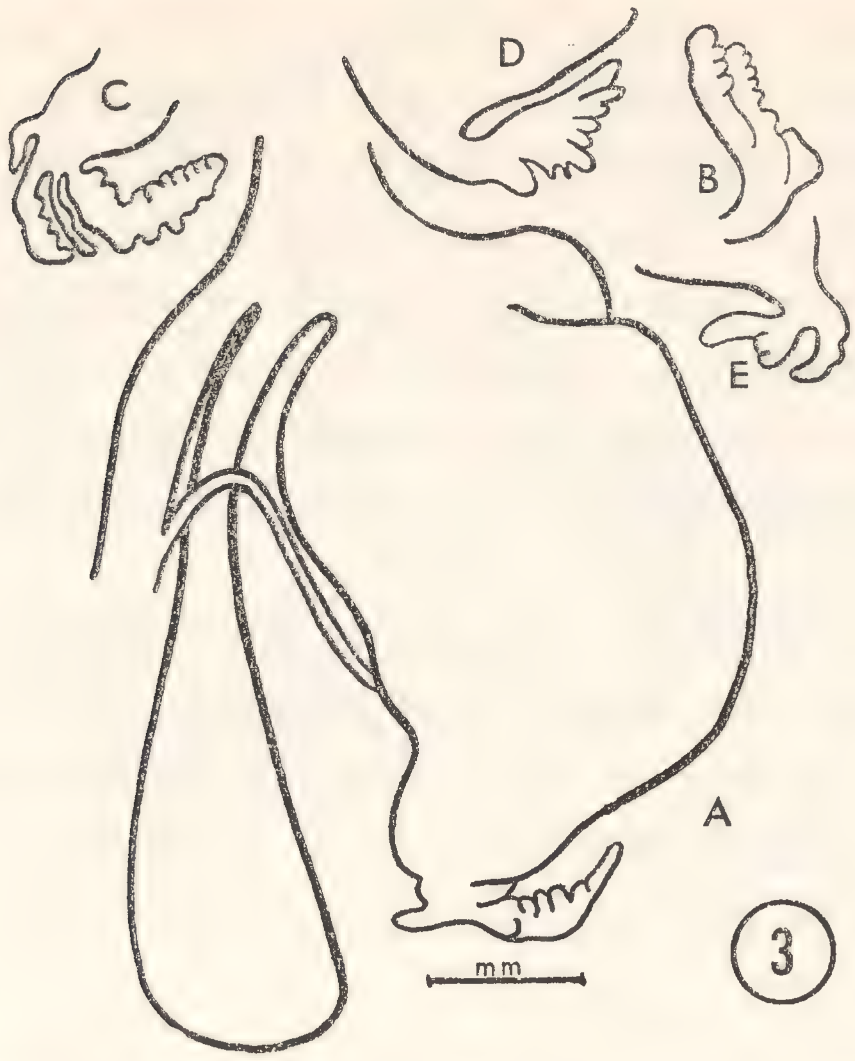
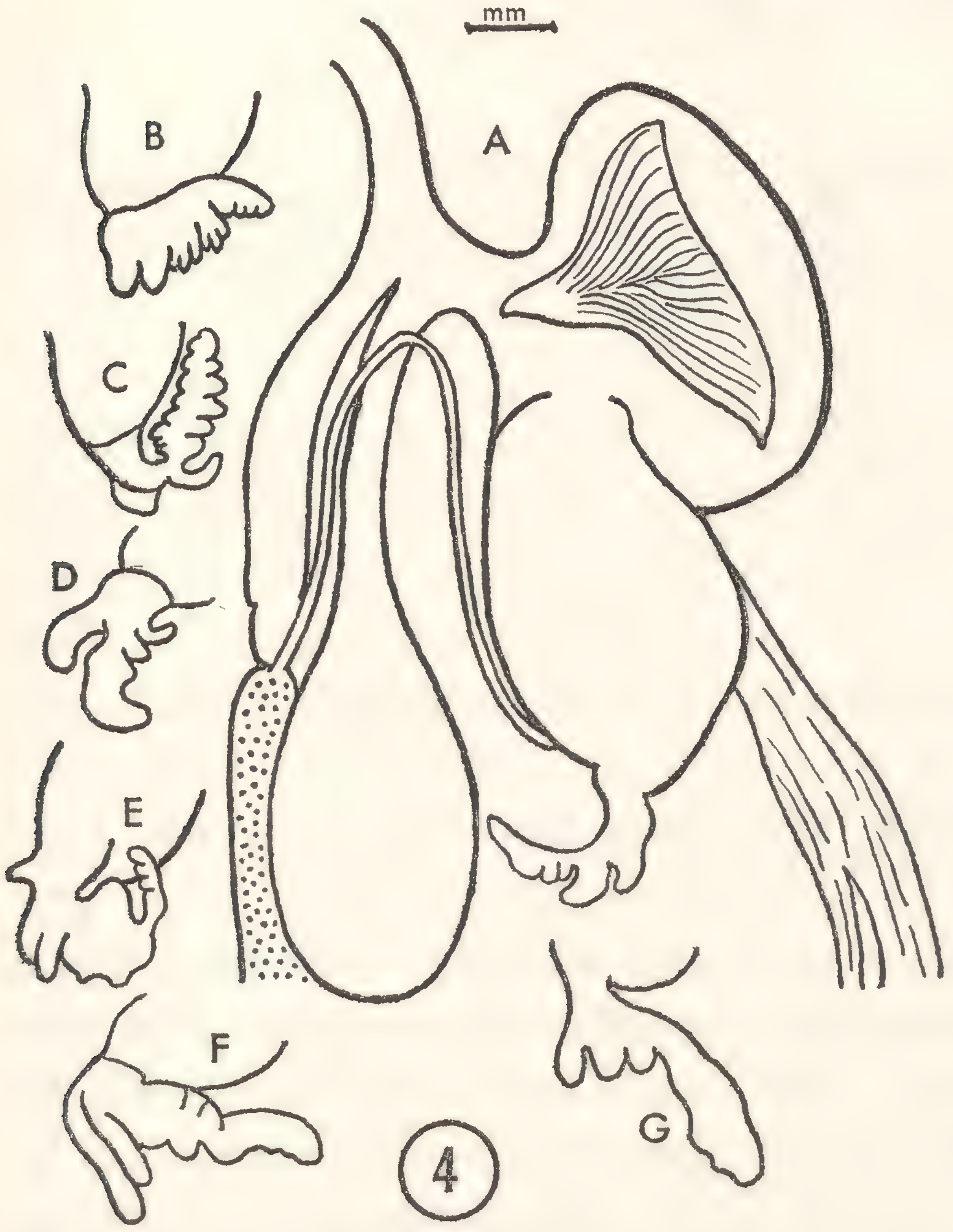


Fig. 3. *Agriolimax reticulatus* (Müller). **A**. Northton, S. Harris, J. G. Evans. **B**. Penzance, Cornwall. **C**. Surlingham Broad, E. Norfolk, C. R. C. Paul. **D, E**. Scapa, Orkney, D. Heppell. **A**. Distal genitalia. **B–E**. Penial appendage.



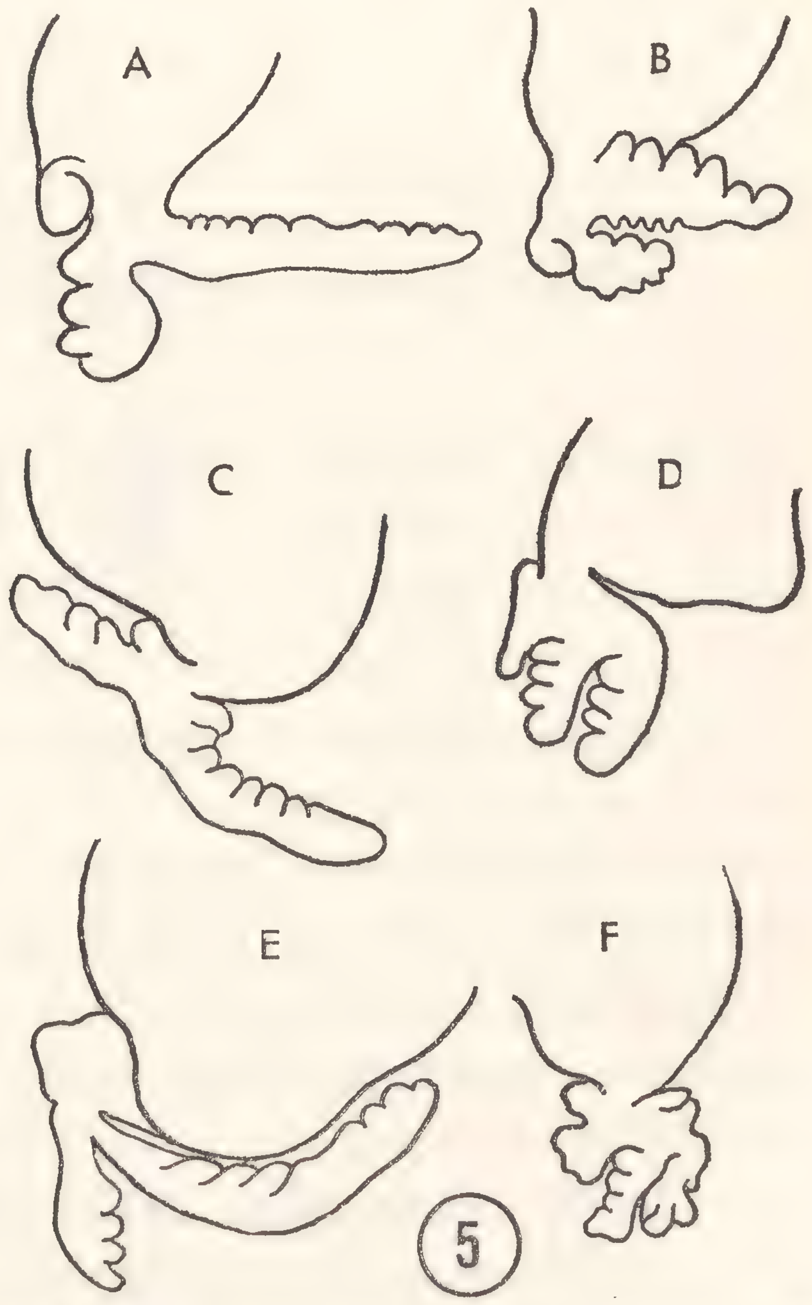


Fig. 4. *Agriolimax reticulatus* (Müller), Carshalton, Surrey. **A**. Distal genitalia (sarcobelum exposed). **B–G**. Penial appendage of six other specimens.

Fig. 5. *Agriolimax reticulatus* (Müller), South Uist, A. R. Waterston. **A–F**. Penial appendage of six specimens from the same locality. **B** and **F** are from individuals superficially resembling *A. agrestis* (L.).

two specimens are ever exactly alike [Figs. 3–5]. The simple digitiform penial appendage of *A. agrestis* affords little scope for variation.

Sometimes the penial appendage appears at first sight to be absent or rudimentary. This is because it becomes turned inside out and extruded during mating, after which it may not return completely to its original everted position, projecting into the haemocoel. When only the tip of the longest digitation of the appendage in *A. reticulatus* projects from the apex of the penis, it could be mistaken for the simple appendage of *A. agrestis*, but can be pulled out to its full extent with forceps.

Agriolimax agrestis is unlikely to be confused with either of the other two British species of this genus, though one habitually and the other occasionally inhabits wet places. *Agriolimax laevis* (MÜLLER) is distinguished by its smaller size, darker colour, clear watery slime and, internally by the sinuous penis, ending behind in a large caecum [Fig. 6]; sometimes the penis is rudimentary or absent. I have not observed this slug ascending the stems of plants and it seems to be tolerant of immersion.

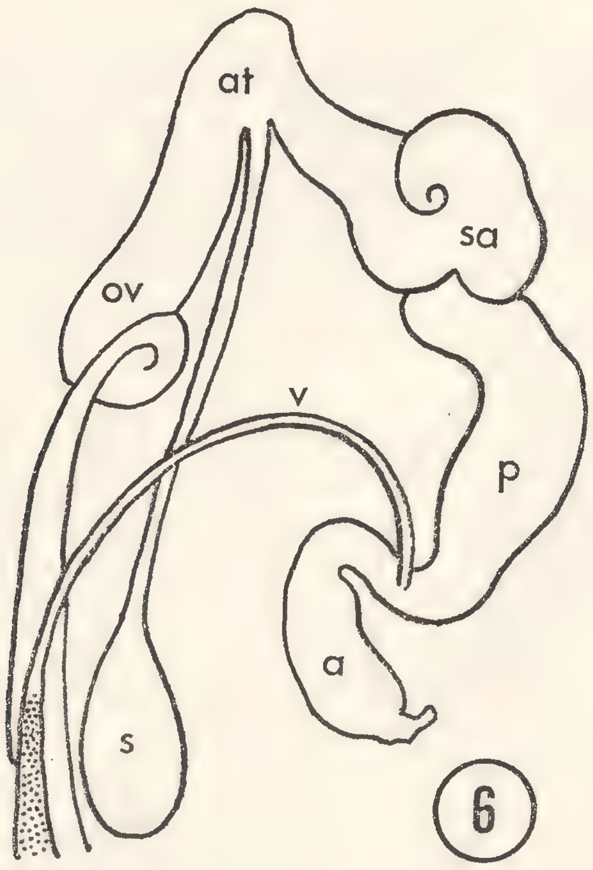


Fig. 6. *Agriolimax laevis* (Müller), Oxford. Distal genitalia. Lettering as in Fig. 1.

Agriolimax caruanae Pollonera, which is recorded from widely scattered localities—mostly gardens—in Great Britain, is rather like a larger and paler version of *A. laevis* and is very lively. Any doubt about its identity is easily resolved by examination of the penis and its appendage, which are most distinctive. The penis has a deep rounded cleft or bay at the apex and reminds one of a boxing glove in shape, though the two unequal lobes or diverticula are not invariably convergent. The penial appendage has four to six slender, nodulose branches of uneven length, rather like the extended tentacles of a hydroid polyp [Fig. 7].

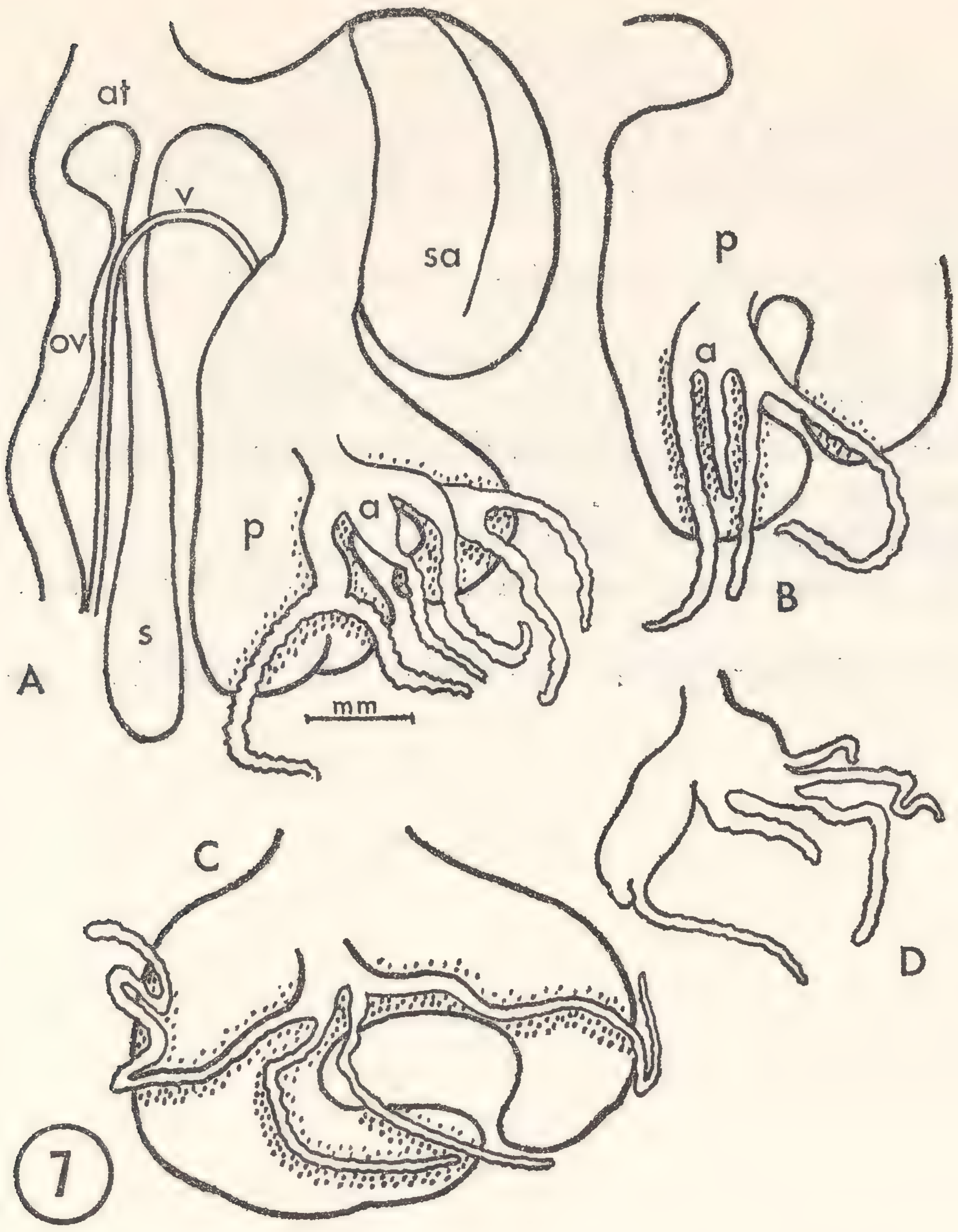


Fig. 7. *Agriolimax caruanae* Pollonera. **A.** Reskadinnick, Camborne, W. Cornwall, Mrs S. M. Turk. **B.** Salisbury, Wiltshire, J. A. Carman. **C, D.** Penzance, W. Cornwall. **A.** Distal genitalia. **B, C.** Proximal (posterior) portion of penis. **D.** Penial appendage. Lettering as in Fig. 1.

A magnifying glass of quite low power is sufficient to examine the genitalia of slugs, though a binocular microscope is preferable, and all that one needs to perform a dissection are small, sharply-pointed scissors, forceps, a mounted needle, small pins and a dissecting dish, which can be made by melting wax (e.g. candles) in a pie-dish (or a sheet of cork weighted with lead can be used). Slugs intended for dissection should be drowned for about 24 hours and then immersed in 30% alcohol (industrial methylated spirit), but should be transferred to 70% alcohol for permanent preservation. The dish should contain enough water to cover the specimen. For a novice it is advisable to practise on common slugs before running the risk of mauling a rare or not easily procurable specimen.

Stimulated by the publications of Dr Quick (the most useful of which is deplorably expensive), more collectors are now taking an interest in slugs and dissecting them, instead of neglecting them or leaving them to specialists. The purpose of this article is to further this good work, for without accurate determination of species based on critical diagnostic characters, any study of their ecology and distribution is impossible.

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J. Conch. **26**: 197–200. (1967)

MONOGRAPH OF THE BRITISH LOWER TERTIARY UNIONIDAE CORRECTIONS AND ADDITIONS

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(*Read before the Society*, 19 *March* 1966)

Since the publication of my monograph of the British Lower Tertiary Unionidae a further new species has come to light, which is described herein. In addition, a number of corrections to my original paper (Woodward, 1965) are listed below.

Corrections

p. 316, line 32: for 'Teritary' read 'Tertiary'.

p. 323, line 18: for 'Bembridge Limestone' read 'Upper Headon Beds'.

p. 323, line 29: for 'SM C.29450' read 'SM C.29540'.

p. 327, line 22: for 'SM C.28489' read 'SM C.29489'.

p. 327, line 34: for 'SM C.28489' read 'SM C.29489'.

p. 327, Table 3: insert 'SM C.29532' and 'SM C.29533'; these specimens were included in *Unio subparallela* Wood on p. 328.

p. 328: material included under *Unio subparallela* Wood, from the Sedgwick Museum, Cambridge [registration numbers SM C.29532 and SM C.29533] is in reality *Unio solandri* J. de C. Sowerby. Therefore delete fifth line under 'Material examined' and the last two lines of dimensions and include these under *Unio solandri* on p. 327.

pl. 22: insert '1. *Unio edwardsii* Wood'.

pl. 23: insert '5. *Unio austeni* Morris'.

All the material listed as in 'FRW Coll.' has since been transferred to the geological collections of the Hunterian Museum, The University, Glasgow.

Additional species

Unio castelli n.sp.

(Plate 9)

Unio gibbsii auctt. non *U. gibbsii* Morris.

Description. Shell equivalve, inequilateral, inflated, elongate oval in outline; umbones slightly elevated, situated approximately one-fourth of the way along the length of the shell. Gonial ridge weakly developed, running diagonally from the umbones to the postero-ventral junction, forming a weak shoulder with a definite post-gonial region. In some individuals the gonial shoulder is transversed by a series of oblique corrugations as in *Unio cumberlandi* Woodward. Growth lines well-marked, regular, slightly raised. Anterior margin rounded; ventral margin straight, or weakly curved in old individuals; posterior margin obliquely truncate; dorsal margin slightly convex, tending to be parallel to the ventral margin. Umbonal rugae in the form of well-defined **W**-shaped rugae in which the two points of the inverted **V**'s are more pronounced, resulting in the development of a pair of divergent rugal nodules similar to those present in the Recent *Anodonta complanata* Rossmässler = *A. minima* auctt. No trace of the ligament is present in the material examined.

The internal features which follow are based on specimens in the Sedgwick Museum, Cambridge, nos. SM C.22054 and SM C.22055. Left valve hinge plate having a single, low, lamelliform pseudocardinal and two well-developed lateral lamellae; umbonal cavities shallow, with the dorso-umbonal muscle scars impressed on to the hinge plate, these being four in number. Anterior adductor muscle scar impressed, reniform in outline, fused dorsally with the anterior retractor-pedis muscle scar which is also impressed. Anterior protractor-pedis muscle scar distinct, impressed, cubic in outline. Pallial scars fused, impressed, forming a distinct pallial line from the base of the anterior adductor muscle scar to the posterior adductor muscle scar which is spade-shaped in outline.

Geological horizon. Oligocene: Hamstead Beds.

Material examined

Holotype: BM LL 18132. Specimen from the F. E. Edwards collection, purchased 1872–73. Type-locality: Hempstead [i.e. Hamstead], Isle of Wight (on the authority of Edwards).

Six paratypes: BM LL 18133, from the F. E. Edwards collection, purchased 1872–73; SM C.22053—SM C.22057, Lower Hempstead Beds, Hamstead, Isle of Wight.

The dimensions of these specimens are as follows:

SPECIMEN	L. (mm)	B. (mm)	H. (mm)
Holotype BM LL 18132	28·0	4·0*	15·5
Paratype BM LL 18133	38·0	5·0*	20·0
Paratype SM C.22053	33·0	5·0*	16·5
Paratype SM C.22054	38·0	3·5*	20·0
Paratype SM C.22055	21·0+	4·5*	15·0
Paratype SM C.22056	32·0	4·0*	16·0
Paratype SM C.22057	27·0+	4·0*	16·0

* = one valve.

This species is named after Mr C. P. CASTELL in appreciation of his considerable help to me in the past and for placing the material at my disposal.

ACKNOWLEDGMENTS

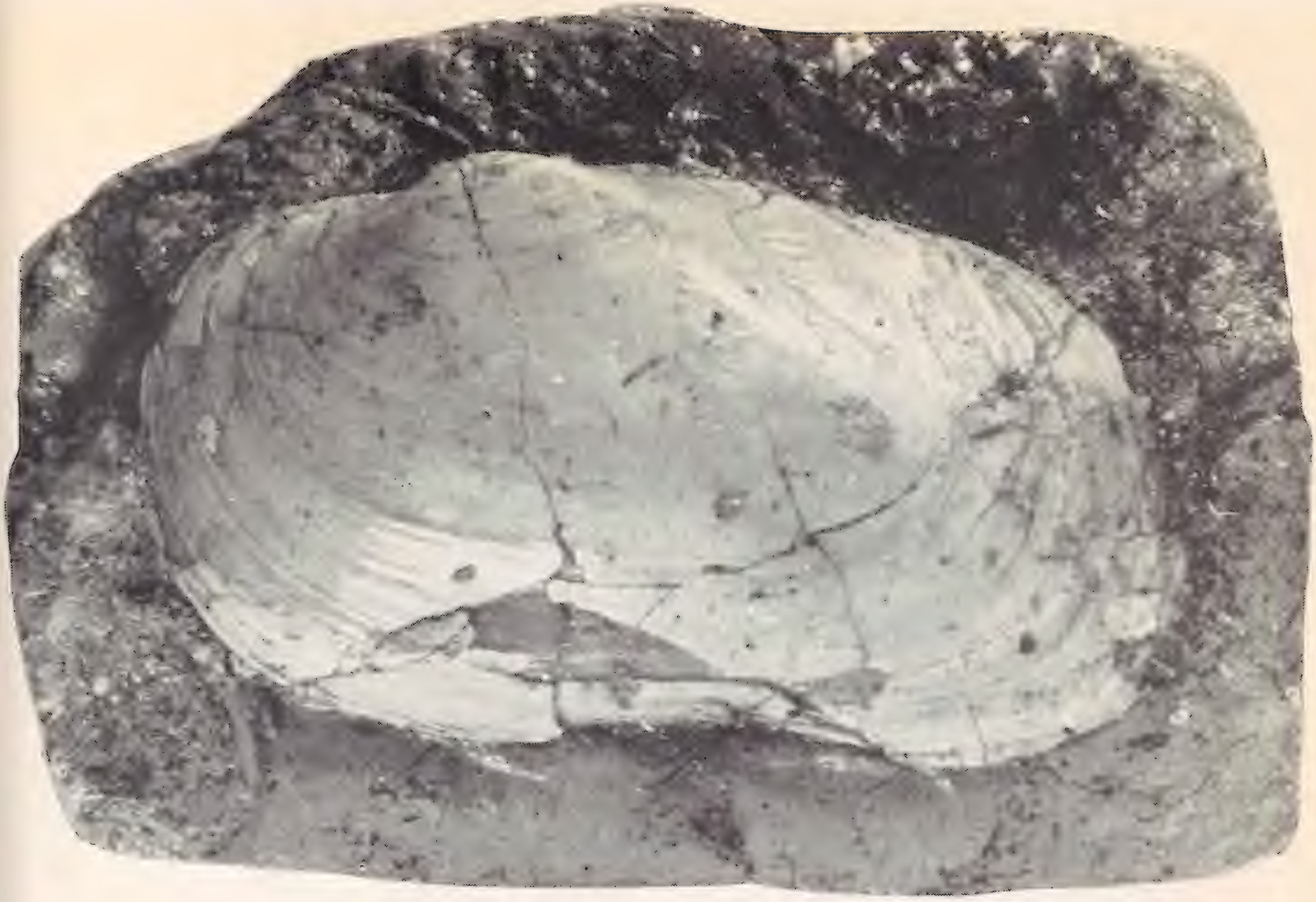
I should like to express my sincere thanks to the British Museum (Natural History); The Sedgwick Museum, Cambridge; Paisley Museum and Art Gallery; and to Mr C. P. CASTELL, Mr T. PAIN and my wife for helpful criticism and assistance during my investigations.

REFERENCE

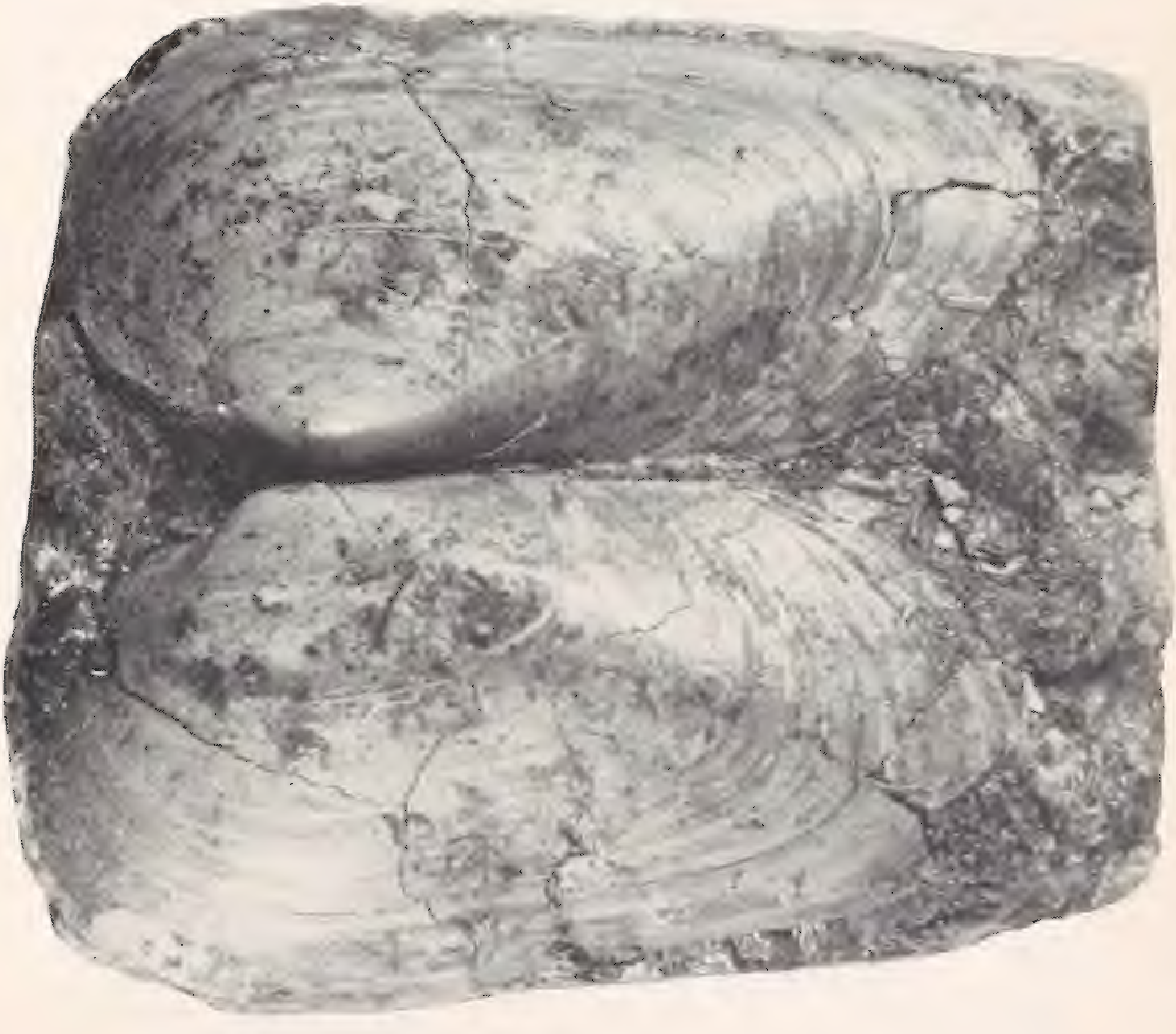
WOODWARD, F. R., 1965. Monograph of the British Lower Tertiary Unionidae, with descriptions of three new species. *J. Conch.* **25**: 316–330, pls. 22–27.

EXPLANATION OF PLATE 9

Figure 1. *Unio castelli* Woodward: holotype, left valve. Lower (?) Hamstead Beds. BM LL 18132.
Figure 2. *Unio castelli* Woodward: paratype, dorsal aspect of both valves. Lower (?) Hamstead Beds. BM LL 18133.
Photos.: R. F. CUMBERLAND.

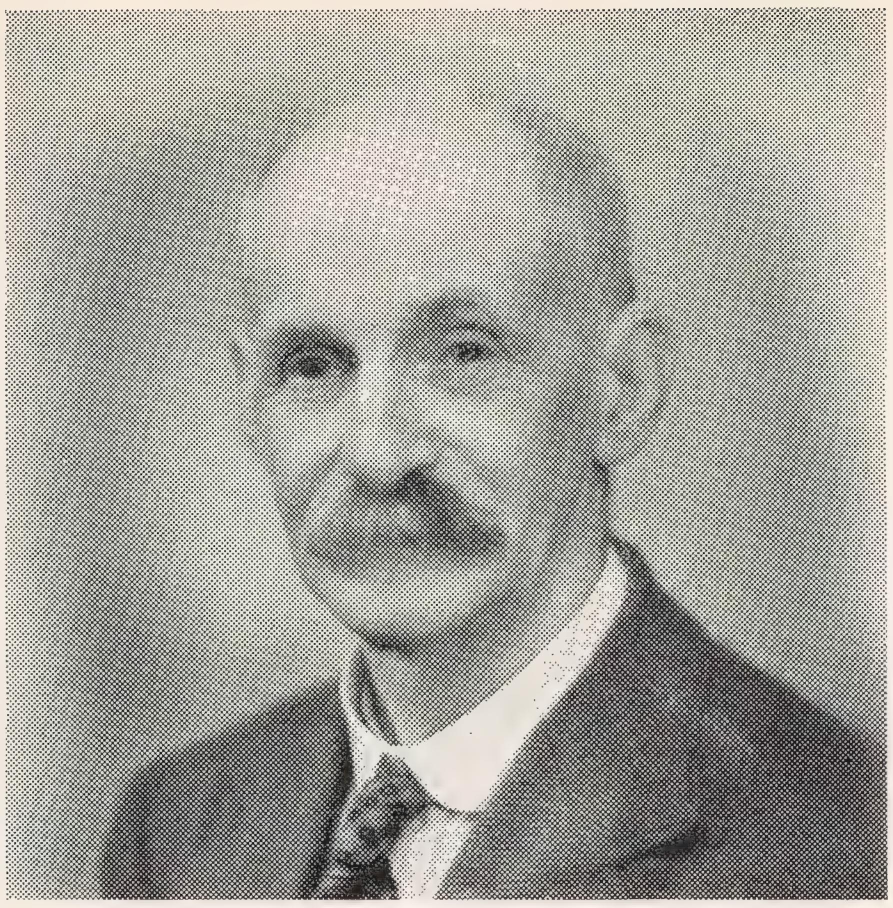


1



2

Unio castelli Woodward



J H Lumb

JAMES HENRY LUMB
1876 - 1966

J. Conch. **26**: 201. (1967)

OBITUARY

J. H. LUMB, 1876–1966

JAMES HENRY LUMB died in St John's Hospital, Halifax, on 21 April 1966. His passing is a severe loss to all local scientific societies.

His working life was spent with the Halifax Corporation Passenger Transport, first in the Tramways Department—he travelled on both first and last trams—and later with the Omnibus undertaking. He worked for 43 years, to retire in 1940 from the position of Chief Town Inspector. During his service with transport he was an active official of N.A.L.G.O. After retirement he was co-opted to represent the Allotments Federation on the Parks and Allotments Committee of Halifax Corporation. He adjudicated at numerous agricultural and horticultural shows, and was an official at the Halifax Show.

LUMB was a member of the Halifax Scientific Society for 63 years. He served as Secretary for two sessions: the first lasted 30 years! In 1949 he was elected President and in 1961, in recognition of his unselfish service, he was made First Life President. He joined the Conchological Society and the Yorkshire Naturalists' Union in 1919 and became a Fellow of the Royal Microscopical Society in 1955. He was active in the field with all local societies, including the Ovenden Naturalists' Society and the Yorkshire Conchological Society of which latter he was made an Honorary Member in 1958, until about three years ago.

He was a 'Naturalist' of the old tradition and his service to the cause of Nature lay particularly in his unfailing wish to help others, as witnessed by his appearance on so many committees and in such onerous offices as Honorary Secretary. His chief loves were conchology and microscopy; he did not publish papers but his knowledge of local conditions was extensive and backed up by wide reading. He would give freely of his time and experience to all who asked for help. He was an outstanding example of that select band of individuals without which local societies would cease to exist; he would undertake willingly the tedious and time-consuming tasks which make for the smooth running of any organization.

LUMB married in 1902, and his wife died in 1956. One remembers with affection Mr and Mrs LUMB as an example of a happily married couple who were ever willing to share their happiness. There are four children, four grandchildren and four great-grandchildren who mourn his passing.

ERNEST DEARING

REVIEWS

Collecting Shells by Stella M. Turk. London: W. & G. Foyle Ltd, 1966. pp. 92, 8 pls. *Foyles Handbooks.* 7¼″ × 4¾″. Price 5s.

The title and chapter headings of this little book suggest that it might be a useful springboard for the bewildered beginner. On a closer examination, however, Stella Turk seems to have written a pocket manual of conchology masquerading as a shell-collector's guide. Most of the 48 line drawings—perhaps the book's most redeeming feature—are well executed and clearly labelled, but the 8 photographic plates—mostly depicting shell bric-à-brac—are of little use to the collector. Nine ingenious and mostly accurate Tables, which one would hardly expect to find here, occupy 14 of the book's 92 pages. Instead of tabulating the 'fore-gilled gastropods', 'lung-bearing gastropods', British fossil molluscs, fossil Cephalopoda of the world, etc., one would have preferred more information on chitons, tusk shells and other molluscs for which there was 'neither the space nor the place' [p. 45]—or possibly an Index. Naturally the book is aimed at the British public, but it is unfortunate that it should take so little notice of exotic shells. On the other hand this deficiency is remedied partially by the references to relevant literature appended to each chapter.

Mrs Turk has been careful to use scientific names in addition to popular names and a chapter on nomenclature and classification is provided. It is a pity, therefore, that many of the scientific names used are misspelt—presumably through no fault of her own; and by using three different popular names for *Nucella lapillus* (L.) ['British Dog Whelk'—p. 16, 'Purple Dog-whelk'—p. 17, 'Dog Whelk'—p. 59], she unwittingly demonstrates one of the main objections to their use. Similarly, some of her cross-references are misleading (fatal in a book lacking an Index). For instance, one should find an illustration of the operculum on Plate 3 [*vide* p. 90] or on Plate 4 [*vide* p. 32]; but neither plate is thus embellished. Inconsistent use of brackets around authors' names and incorrect authorities for specific names are almost expected in any book on shells, and this one is no worse an offender than most; but *Cypraea annulus* Adams (!) [p. 15] is not easily forgiven.

The few errors of fact are mostly trivial but one or two merit correction here. The cowry is said to have symbolized birth, 'presumably because of the fancied resemblance to childbirth as the animal emerged from the narrow shell' [p. 13]: it is generally considered that the shell was likened to female genitalia. Cuvier is said to have first coined the word 'Mollusca' in 1798 for squids and cuttles [p. 19]: this is to deny priority to Aristotle who coined the same word for the same creatures rather earlier. Metal figurines of Buddha are said to have been introduced between the shell and mantle of *oysters* by orientals, who subsequently removed them encased in mother-of-pearl [p. 21]: the shells so utilized were *fresh-water mussels* of the family Unionidae. W. F. Webb's *Handbook* is said to be obtainable from W. F. Webb [p. 47]: he is dead.

To sum up, Mrs Turk has written a useful, though not immaculate, book. Its line drawings, references to other works and its novel approach can be recommended; but it is doubtful if it does the job suggested by its title (which, incidentally, is given correctly everywhere except on the title-page).

S. P. Dance

A Glossary of a thousand-and-one terms used in Conchology compiled by Winifred H. Arnold. *The Veliger*, Supplement to Volume 7. Berkeley, California: California Malacozoological Society, Inc., 1965. pp. 50, 155 text-figures. 11″ × 8½″. Price U.S. $2.35.

This detailed glossary, which actually contains nearly two thousand main headings and numerous subsidiary ones, is drawn from such a comprehensive field that one might almost have expected to find a definition of 'critic' in its pages. The *Shorter Oxford English Dictionary* includes a warning against such people in quoting Thomas Dekker's axiom: 'Take heed of criticks: they, like fish, bite at anything, especially at bookes'. Indeed, biting as well as barking must be considered one of their tasks. Barks of pleasure are warranted by the appearance of WINIFRED ARNOLD's painstaking compilation of such an exhaustive glossary of words likely to be encountered both by conchologists and by students of the brachiopods. It should be made clear that 'Conchology' is used here in the restricted sense of a study of the Mollusca based on the hard parts, in contradistinction to the later word 'Malacology': the soft parts, with few exceptions, are not listed. Mr S. P. DANCE discusses 'this unfortunate dichotomy' of terms in his recent book *Shell Collecting*, deprecating the many inconsistencies that have arisen from the use of separate names for what are no more than aspects of the same study.

Other glossaries are available, but for one reason or another these are incomplete. The *Treatise on Invertebrate Paleontology* is presenting a definitive one, class by class, but not only are all terms on the periphery of conchological studies excluded, but a glossary for the bivalves is yet to appear. Moreover, the present work includes derivations for each entry, followed by the meaning, succinctly expressed and, often, actual taxonomic examples: these last, to quote E. C. JAEGER's words in *A source-book of biological names and terms*, indicate 'a treasure house of meaning carrying valuable clues to identification, rich allusions to scientific history and discovery' inherent in all well-chosen scientific names. The numerous figures are carefully selected to illustrate the more important terms used in the text and are placed conveniently near the references.

Having regard to the undeniable excellence of this work, it seems certain that a re-printing will be needed. In that event it may not be unhelpful to call attention to a few points that will be worth noting and which are in no sense intended as adverse criticisms of this first edition.

American and English usage of terms for the geological time scale are sufficiently different and the glossary likely to be so extensively used in the English speaking world, that inclusion of the main European terms and their correlation would be of great use, e.g. 'Carboniferous', 'Primary', 'Secondary', 'Tertiary', 'Quaternary' and 'Holocene'.

Errors and omissions are very few, but include 'acephalous', 'Bivalvia', 'gene' (although 'genetic effects' has a heading), 'synonym' and 'trochophore'. The Amphineura are mentioned as one of the *five* classes of molluscs, the Monoplacophora being ignored and the Aplacophora and Polyplacophora are not listed, although the latter two are ranked as classes by some authorities. 'Pelecypoda' appears with a small initial, and 'subspecies' with a hyphen.

The inclusion of an abbreviated reference to the languages from which the various words are derived is an important aspect of the work. An error of appropriately small dimensions may be spotted under 'clausilium' which surely comes from the New Latin diminutive for 'clausum'—a closed space—rather than from 'claudo'—I close. Also 'amphi-' in the name 'Amphineura' is more happily rendered as 'double' or 'on both sides' rather than 'around'.

Completely concurring with the compiler that much interesting information is lost to the reader if he is unable to understand the terminology used, and that chasing interpretations is frustrating, the reviewer suggests that this publication will help all students of Conchology, including those who have forgotten more than most of us will ever know: for these it will serve as an *aide-mémoire*. And the price is very modest.

STELLA M. TURK

Cephalopods of the Seas of the U.S.S.R. by I. I. AKIMUSHKIN. Translated from the Russian by A. MERCADO. Jerusalem: Israel Program for Scientific Translations, 1966. Distributed in the U.K. by Oldbourne Press, London. pp. viii + 223, 60 text-figures. *IPST Cat. No.* 1384. 9¾″ × 6¾″. Price 63s or U.S. $8.75. [First published as *Golovonogie mollyuski morei SSSR*. Moskva: Akademiya Nauk SSSR, 1963. *Fauna of the U.S.S.R.*]

Teuthologists will welcome an English translation of AKIMUSHKIN's monograph: valuable information is thus made available concerning the cephalopods of the North Pacific.

More than half the book is devoted to systematic descriptions of cephalopods taken by research vessels of the U.S.S.R., but there are also chapters on morphology, biology, geographical distribution, and economic uses of cephalopods. This last contains much that is interesting, and not a little that is entertaining, and the chapter on biology is full of fascinating information on growth, reproduction, feeding habits, seasonal migration, etc. Tantalizingly, some of the most interesting observations are given with no reference through which they could be followed up in detail. The chapter on geographical distribution is thoughtful and thought-provoking. The writer puts forward the view that the Indo-Pacific area is the evolutionary centre for modern cephalopods, and produces some stimulating arguments in support of his thesis. Not all his arguments are sound (the present-day distribution of the genus *Nautilus* can hardly be used as evidence in view of the wide-spread distribution of the genus in fossil form); but many are convincing, and no serious reader will feel free to reject the conclusion here offered without feeling challenged to think out an alternative; the most truly fruitful outcome of imaginative hypothesis.

The records of vertical distribution do not stress enough the dangers attached to records from great depths, unless closing nets have been used, or very careful corrections made. Some of the records are inaccurate. *Spirula* can hardly be said to be 'most common at 2,000–4,000 m', and *Ommastrephes*, while frequently appearing at the surface, has been photographed by workers on 'Discovery II' taking bait at a depth of 1,000 m.

The systematic account contains few figures but gives numerous references to those in *Studies of the Far Eastern Seas of the U.S.S.R.* by Kondakov (1941), and these figures are clearly intended to be used to assist in identification. The data for the maps of distribution have been gathered from a number of sources: it is unfortunate that the maps have been so much reduced (possibly in the translated edition only) that the various marks indicating different species are blurred and sometimes almost indistinguishable.

In reading this section, its restricted scope must be borne in mind. Like Naef's monograph on the cephalopods of the Bay of Naples, this is a list of species from one area, and the keys for identification are explicitly designed to fit only the species mentioned. This also applies to the key based on beaks, which is accompanied, however, with some clear and useful drawings.

Some omissions from the list are at first sight puzzling. No species of *Sepia* or *Loligo* appears although there is evidence (e.g. in the records of the distribution of *Rossia pacifica*) that the expeditions had actually collected along the coasts of Japan, where species of both genera are to be found. It would seem that species are listed from this area only if they also occur in more northern waters. It would have been helpful to have had this explicitly stated, since this fact adds greatly to the value and interest of the list, and to its limitations.

It may be the absence of *Loligo* or *Sepioteuthis* from the species considered which accounts for the author's adherence to the old division of the decapods into 'Myopsida' and 'Oegopsida' instead of the divisions Sepioidea and Teuthoidea, long since introduced by Naef, whereby the Loliginidae are placed together with the other, oegopsid squids. More surprising is the inclusion of the Vampyromorpha with the Cirromorpha in the 'Pteroti' and the persistent use of the old vampyromorph genera *Danateuthis, Watasella*, etc. This is surprising in that the author quotes freely descriptive detail from the papers of Pickford, who showed convincingly that all vampyromorph 'genera' and 'species' are growth stages of *Vampyroteuthis infernalis* Chun, and represent an order distinct from either the Octopoda or Decapoda. This error is unfortunate in that it vitiates any generalization made about the 'Pteroti'.

The author has not been altogether fortunate in his translator, who is clearly not familiar with English cephalopod terminology. Thus, confusion is constantly introduced by naming the glandular funnel-organ the 'infundibulum' and describing it as cartilaginous, while at the same time referring to 'infundibular cartilages' in the accepted sense of the locking apparatus between funnel and mantle. In the same way, a number of textual errors have been missed as when the word 'siphuncle' replaced 'rostrum' in the account of the Belemnoidea. For these errors the unfortunate author is in no way to blame, and they diminish greatly the value to the general student of what is otherwise a useful introductory chapter.

The errors named, either in text or translation, do not, however, prevent this work from being an important and stimulating addition to cephalopod literature; a value enhanced by a long bibliography with English translations of all Russian titles.

Anna M. Bidder

The Oysters of Locmariaquer by Eleanor Clark. London: Secker & Warburg, first published in England 1965. pp. 203, 3 drawings + 1 map. 8vo. Price 25s.

This book is about oysters—their history and biology—and about the people of the conservative district of Brittany known as the Morbihan: twin themes bound together by the author's interest in and sympathy with her subject. Unfortunately, the twins take on a 'Siamese' character: one upsets the other and neither fares well. You may, nevertheless, enjoy this book—which is racy in style and, in parts, witty—for light reading.

John Bowden

Brachiopoda by A. Williams, A. J. Rowell *et al.*, edited by R. C. Moore. New York: Geological Society of America and The University of Kansas Press, 1965. 2 vols. pp. xxxii + 927, 746 text-figures. *Treatise on Invertebrate Paleontology* Part H. 9½″ × 7″. Price U.S. $19.50.

Of the *Treatise* volumes so far published, the two on the brachiopods are exceptionally impressive. They not merely provide a conspectus and a catalogue of the phylum but add greatly to knowledge, especially in morphology, and offer a radical critique of systematics and phylogeny.

The abundance and variety of fossil forms, and the comparative rarity of living, have contributed to a past emphasis on the more obvious features of the brachiopod shell as being a guide to affinities that may be readily expressed. These affinities are now shown to be much too simply conceived or to be erroneous in the light of refined studies in shell structure, which allow analogies and homologies of shell elements to be securely established on morphogenetic equivalence, and which prompt a revised classification. The morphological sections in Volume I provide a vast amount of information on detailed shell structure and 'ornament', on growth and growth-changes of the pedicle and the pedicle opening, on modes of articulation and related musculature, on mantle canals, on the lophophore and its brachidial supports, and on the relations of the shell elements to the mantle, all of it of intrinsic value and all of it contributing to the derivative discussion on affinities and evolution. Not the least welcome pages give a full index of the hundreds of morphological terms used in describing brachiopod structure.

In the result, a simple hierarchical classification after the manner of Beecher, is shown not to be appropriate. The phylum is riddled by parallelism and convergence in the development of almost all elements of the shell, no truly 'differential' characters being available for establishing absolute barriers between one systematic group and another. Moreover, the homoeomorphy is reflected in parallel ecological adaptations that in the recurrence of similar forms in similar facies are commonly widely heterochronous, the apparent homologues being separated by lengthy time-intervals when annectants do not seem to have lived. Classification is then best established—although it is always a subjective and not obviously a 'natural' classification—by construction from below through species and genus to family and order and not by imposition from above in repeated dichotomy. Most brachiopods may still be referred either to the Inarticulata or to the Articulata; but the ten orders of the two classes are uncertainly linked and do not happily fall into Atremata and Neotremata, Protremata and Telotremata—subclasses that are rejected. In bulk, half of Volume I and the whole of Volume II are devoted to a catalogue and brief diagnoses, with taxonomic details, of orders, families, and all known genera, every genus illustrated usually in type-species.

The division of the work amongst seventeen authors does not always contribute to a uniformity of method in description or of taxonomic criteria in classification, and the independent reader is not likely uncritically to accept all the phylogenetic implications or the strictly morphological bases on which families and genera are founded; but the immense and comprehensive store of information contained in the volumes, the thoroughness with which the compilation has been carried out, and the highly instructive discussion of evidence, principle, and theory that permeates the text combine to make this Part of the *Treatise* in its substance and authority an outstanding contribution to palaeontology.

T. Neville George

ACCOUNTS FOR THE YEAR ENDING 31 DECEMBER 1965

Income and Expenditure Account

Dr.

	£ s. d.	£ s. d.
To Membership Fees:		
Paid in 1964	47 8 9	
Paid in arrear	5 0 0	
Current	268 3 4	
		320 12 1
Subscriptions (non-members):		
Paid in 1964	30 1 6	
Current	84 16 8	
		114 18 2
Sales		55 19 5
Donations		4 13 0
From Life Membership Fund		21 0 0
From Dividend Account		52 17 11
Excess of Expenditure over Income		67 10 10
		£637 11 5

Cr.

	£ s. d.	£ s. d.
By Publication and Distribution:		
Volume 25, part 7	269 5 5	
Authors' Reprints	38 1 0	
		307 6 5
Newsletters		143 2 5
Student Papers		38 13 9
Subscriptions and Donations		4 15 0
Printing and Stationery		70 5 5
Officers' Expenses		33 2 6
Agenda of Field Meetings		9 18 7
Census Expenses		28 7 4
Speaker's Expenses		2 0 0
		£637 11 5

Life Membership Fund

Dr.

	£ s. d.
To Amount of Fund, 31 December 1964	670 0 0
Two additional Members	40 0 0
Dividends and Interest from Dividend Account	21 0 0
	£731 0 0

Cr.

	£ s. d.
By Transfer to Income and Expenditure Account	21 0 0
Amount of Fund, 31 December 1965	710 0 0
	£731 0 0

Reserve and Research Fund

Dr.

	£ s. d.
To Amount of Fund, 31 December 1964	989 0 0
Dividends and Interest from Dividend Account	30 0 0
	£1019 0 0

Cr.

	£ s. d.
By Amount of Fund, 31 December 1965	1019 0 0
	£1019 0 0

Dividend Account

Dr.	£	s.	d.
To 4% Funding Loan	16	6	6
3% Funding Loan	3	0	0
4½% Defence Bonds	9	0	0
3½% War Stock	1	8	4
5% Treasury Stock	20	0	0
4% British Gas Stock	16	0	0
3% Savings Bonds	6	0	0
5⅝% City of Norwich Mortgage Loan	13	10	0
5½% London County Council Mortgage Loan*			
Income Tax refund	13	7	2
Post Office Savings Bank	5	5	11
	£103	17	11

Cr.	£	s.	d.
By Transfer to Life Membership Fund	21	0	0
Transfer to Reserve and Research Fund	30	0	0
Transfer to Income and Expenditure Account	52	17	11
	£103	17	11

* Interest on this investment has been paid by the Bank of England to the *former* Senior Trustee who has failed to hand over the various Warrants. Legal action has been taken and the amount due has been recovered and will be shown in the Accounts for 1966.

Balance Sheet

Dr. *Liabilities*	£	s.	d.	£	s.	d.
To Membership Fees paid in advance				49	15	0
Subscriptions paid in advance				76	11	5
Life Membership Fund				710	0	0
Reserve and Research Fund				1019	0	0
Capital Stock				800	0	0
Balance, 1 January 1965	815	10	9			
Less excess of Expenditure over Income carried to Income and Expenditure Account	67	10	10			
				747	19	11
				£3403	6	4

Cr. *Assets*	£	s.	d.	£	s.	d.
By 4% Funding Loan (Cost)	350	0	0			
3% Funding Loan (Cost)	81	10	0			
4½% Defence Bonds (Cost)	200	0	0			
3½% War Stock	20	0	0			
5% Treasury Stock (Cost)	344	0	0			
4% British Gas Stock (Cost)	324	10	0			
3% Savings Bonds (Cost)	143	5	0			
5⅝% City of Norwich Mortgage Loan (Cost)	400	0	0			
5½% London County Council Mortgage Loan (Cost)	769	4	0			
				2632	9	0
Cash:						
At National Provincial Bank	536	3	6			
At Post Office Savings Bank	234	13	10			
				770	17	4
				£3403	6	4

NOTE: In addition to the Assets shown above are outstanding subscriptions and debts, the stock of Journals, and Interest on the L.C.C. loan.

Examined and found correct.
M. MAITLAND HOWARD } Auditors.
P. COXHEAD
13 February 1966

C. A. RAFFRAY,
Hon. Treasurer.
5 January 1966.

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

829th (Annual General) Meeting, held at the British Museum (Natural History), 19 February 1966

Mr A. E. ELLIS, Vice-President, in the Chair.

Members Elected

G. S. MORRISON, 49 Daines Way, Thorpe Bay, Essex.
J. D. ORR, Lavender Cottage, Popps Lane, Cooden, Bexhill, Sussex.
D. C. RIVETT-CARNAC, O.B.E., B.A., c/o Office of the Political Adviser to the C.-in-C., F.E., Phoenix Park, Singapore.
Miss ANGELA R. WHITE, 48 Queens Road, Clarendon Park, Leicester.

Appointment of Scrutineers

Mr R. J. CLEEVELY and Mr D. G. PICKRELL were appointed Scrutineers.

Election of Auditors

Miss M. MAITLAND HOWARD and Mr C. W. PETTITT were elected Auditors.

Annual Reports

The Reports of the Council, the Recorders for non-marine and marine Mollusca, the Field Meetings Organizer, the Junior Section Leader, and the Curator were presented and adopted. The Hon. Treasurer presented the audited accounts for 1965 (see p. 206), which were adopted.

Report of the Council

MEMBERSHIP. Fifty-two Members were elected during the year, compared with forty-five last year, and one was reinstated (subject to Council approval). Fifteen resignations have been received, eight Members have been removed from the lists under Rule 5, and the Society has lost one, Mr C. J. GABRIEL, by death. The net gain in Membership is, therefore, twenty-eight. The total Membership is now 347, of which seventeen are Life and three are Honorary Members. The number of Subscribers, at 120, again shows a slight rise.

MEETINGS. One annual general meeting, one special general meeting, and seven ordinary meetings have been held at the British Museum (Natural History), by kind permission of the Trustees, the average attendance being forty-one as against thirty-seven last year.

PUBLICATIONS. The publication of Volume 25, No. 8 of the *Journal of Conchology*, printed under a new contract, was badly delayed by circumstances outside the Society's control and, although dated 9 December 1965 and published on 17 December, was not actually in the post to Members until early January. Volume 26, No. 1, in new format, and itself part of the 1965 issue series, is expected very shortly. Of the *Conchologists' Newsletter*, issues were made in March, June, September and December; and of the *Papers for Students*, Nos. 5 and 6 were issued in July. Reprinting of the updated Census Number (Boycott Memorial) and the out-of-print Volume 25, No. 7 is proceeding.

TRUSTEES. The Society has had to take legal advice for the recovery of bonds and dividends which were not otherwise forthcoming from its former senior Trustee, and this has been a matter of considerable concern to the Council, but it is believed that a satisfactory termination is now being reached. The Society's current Trustees are Messrs J. F. M. DE BARTOLOMÉ and C. A. RAFFRAY.

Recorder's Report: non-marine Mollusca

A. 10-KILOMETRE SQUARE MAPPING

Once again, this has been a somewhat disappointing year for the scheme. Only a relatively small number of cards, yielding in all about 4,000 fresh records, have been sent in. If you think that you can help, please let me know; I should be particularly glad of any lists from Ireland. Those who would like to gain a better idea of the 10-kilometre square mapping scheme and its possibilities are recommended to refer to the *Atlas of the British Flora* (London: Nelson & Co., 1962).

Since the publication of the last report (*J. Conch.* **26**: 77), it has been decided to segregate records made earlier than 1950, so as to try and obtain as good a coverage of up-to-date information for the whole of Britain as is possible. To December 1965 about 13,500 such recent records had been catalogued. The older records will be used on the distribution maps only if more modern information is not forthcoming from the same 10-kilometre squares, and will be shown by a separate symbol. It is in any case apparent that perhaps 2,000 out of 3,500 or so 10-kilometre squares in Britain have never been examined by conchologists.

Many people are still not marking on their record cards those species which they find in a particular area *only* in close association with gardens, rubbish tips, or otherwise humanly-disturbed habitats. It would increase the value of the scheme very greatly if they would do so; such species should be prefixed with a 'G'. The status of the following should be particularly noted: *Testacella* spp., *Helix aspersa, Hygromia striolata, Arion hortensis, A. lusitanicus, Oxychilus draparnaldi, Milax* spp., *Limax maximus* and *L. flavus.*

B. VICE-COUNTY RECORDS

Since the publication of the last Recorder's report, the following new vice-comital records have been verified:

Cornwall East (2): *Arion lusitanicus*, Stroptide (opposite Padstow), Miss E. I. HARVEY, October 1965; Hawkes Wood, Lower Treneague, Miss D. STEWART, October 1965; *Helicella itala*, Rock and Brea Hill, Mrs J. A. PATON, June 1965.

Somerset North (6): *Pisidium moitessierianum*, River Chew, D. G. PICKRELL, October 1965.

Wilts South (8): *Arion lusitanicus, Milax budapestensis, Agriolimax caruanae*, Salisbury (garden), J. A. CARMAN, September 1965.

Dorset (9): *Limax cinereoniger*, Buck Hill, Cerne Abbas, J. B. HALL, August 1965.

Isle of Wight (10): *Anodonta anatina*, Alverstone, B. THISTLETON, October 1964.

Kent East (15): *Vitrina major*, Bysing Wood, Faversham, M. P. KERNEY, May 1965 (*det.* L. LLOYD-EVANS).

Essex South (18): *Vertigo antivertigo, Arion subfuscus, Agriolimax laevis, Pisidium obtusale*, Epping Forest near Loughton, J. G. EVANS, October 1965.

Berks (22): *Milax budapestensis* (with *M. gagates*), *Agriolimax caruanae*, Reading University Horticultural Station, Shinfield, Miss J. CHATFIELD, December 1965.

Pembroke (45): *Arion rufus*, Skomer Island and Marloes, D. R. SAUNDERS, November and December 1965.

Caernarvon (49): *Milax budapestensis*, Efailnewydd, Pwllheli, Mrs M. FOGAN, December 1965.

Lancaster West (60): *Planorbarius corneus*, Lancaster canal, Woodplumton, Mrs M. FOGAN, May 1965.

Westmorland (69): *Arion rufus*, Finisthwaite, G. D. HYSLOP, July 1965.

Cumberland (70): *Pisidium henslowanum*, Cotehill, E. BLEZARD, October 1965.

Dumfries (72): *Anodonta cygnea*, Castle Loch, Lochmaben, P. S. MAITLAND, April 1965 (*per* A. R. WATERSTON).

Ayr (75): *Pisidium obtusale*, near Auchinleck, September 1941; *P. hibernicum*, Drumlamford Loch, Barrhill, August 1932; both A. R. WATERSTON.

Renfrew (76): *Pisidium casertanum, P. personatum*, Blackbyres, Paisley; *P. obtusale, P. subtruncatum*, near Bridge of Weir; *P. milium*, Hurlet; all A. R. WATERSTON, 1941.

Roxburgh (80): *Testacella haliotidea*, Kelso High School, D. J. WATSON, September 1962 (*per* A. R. WATERSTON).

Haddington (82): *Leucophytia bidentata*, near Dunbar, J. Laskey, *c.* 1800—the type-locality (Montagu, *Testacea Britannica* **Supplement**: 100).

Perth West (87): *Pisidium pulchellum*, Goodie Water near the Lake of Mentieth, A. R. Waterston, May 1935.

Perth East (89): *Planorbis carinatus*, Loch Dunmore, Pitlochry, A. R. Waterston, March 1957.

Easterness (96): *Lymnaea auricularia* var. *acuta*, Loch Loy; *Planorbis albus*, Geddes; *Zonitoides excavatus*, by River Findhorn near Coulmony House; all I. D. Finney, October 1965.

Main Argyll (98): *Leucophytia bidentata*, Oban, Lady Margaret McRae Collection, Royal Scottish Museum (*per* A. R. Waterston).

Clyde Isles (100): *Leucophytia bidentata*, Cumbrae, Robertson Collection, Royal Scottish Museum (*per* A. R. Waterston).

Ross West (105): *Hygromia subrufescens*, *Monacha granulata*, Kishorn, A. McG. Stirling, July 1964; *Cochlicella acuta*, near Achiltibuie, L. Lloyd-Evans, July 1965.

Sutherland West (108): *Pyramidula rupestris*, Balnakeil and Borralie, near Durness (confirmation of old record); *Acanthinula lamellata*, Creagan na Speireig near Loch Hope; *Balea perversa*, Eriboll; all L. Lloyd-Evans, July 1965.

Outer Hebrides (110): *Valvata piscinalis*, Loch Stilligarry, South Uist, A. R. Waterston, June 1965.

Galway North-east (H 17): *Vallonia costata*, *V. excentrica*, *Zonitoides excavatus*, Derreen, Newtown, Miss J. Brockbank, October 1965.

Westmeath (H 23): *Vallonia excentrica*, *Cecilioides acicula*, Killinure Point, Lough Ree, Miss J. Brockbank, October 1965.

Donegal East (H 34): *Vallonia excentrica*, Culoort Bay, Malin Head, L. Lloyd-Evans, April 1965.

Segregates of *Carychium*, *Cochlicopa* and *Vitrea* have been authenticated from the following vice-counties:

Caerychium minimum: 3, 16, 19, 20, 21, 40, 60, 75, 84, 85, 87, 88, 92, 95, 99, 100, 105, 108, 110.

C. tridentatum: 10, 36, 52, 82, 85, 87, 88, 95, 96, 100, 104, 105, 108, 110, H 2.

Cochlicopa lubrica: 4, 9, 11, 13, 15, 16, 17, 18, 19, 20, 22, 23, 27, 29, 31, 35, 36, 40, 41, 49, 50, 52, 54, 56, 57, 59, 60, 64, 65, 69, 70, 72, 74, 75, 76, 78, 81, 82, 83, 84, 85, 87, 88, 89, 92, 93, 95, 96, 97, 100, 102, 104, 105, 108, 110, H 16, H 17, H 23.

C. lubricella: 4, 11, 12, 27, 30, 45, 52, 56, 60, 70, 72, 74, 75, 78, 81, 83, 87, 92, 97, 100, 104, 105, 108, 110.

Vitrea crystallina: 3, 5, 9, 11, 13, 16, 19, 22, 23, 29, 33, 36, 45, 49, 50, 56, 60, 69, 76, 78, 82, 83, 84, 85, 89, 95, 96, 100, 102, 105, 108, 110, 111, H 3.

V. contracta: 0, 3, 5, 9, 12, 13, 15, 19, 20, 22, 23, 24, 36, 41, 45, 50, 51, 56, 69, 70, 76, 82, 83, 84, 85, 87, 88, 89, 95, 96, 104, 105, 108, 110, H 2, H 9, H 23.

M. P. Kerney

Recorder's Report: marine Mollusca

Only a few new records have been received during the past year. The most interesting are as follows:

Acanthochitona communis (Risso), one specimen, Auchinish, Co. Galway, Mrs A. M. Brockbank, October 1965. This appears to be the first record of this chiton from Ireland.

Pycnodonte cochlear (Poli), four living specimens, 'Sarsia' Station 377C, about 300 miles SW. of the Isles of Scilly at 94 fathoms, D. Heppell, June 1964. The first British record (see *J. Conch.* **26**: 122).

Thyasira equalis (Verrill & Bush), Fladen ground, North Sea, about 125 miles NE. of Aberdeen at *c.* 80 fathoms, McIntyre. The first British record (see *J. mar. biol. Ass. U.K.* **41**: 599–616 (1961)).

Some specimens of *Ensis* collected by Mrs N. F. McMillan at Newcastle, Co. Down, were identified by R. M. van Urk as *E. minor* (Chenu) and *E. phaxoides* Urk. This is the first record from Ireland of these two recently differentiated species (see *Ir. Nat. J.* **15**: 112 (1965)).

Exotic shells. A specimen of the Indian Ocean venerid *Gafrarium divaricatum* (Gmelin) was found alive at Walton-on-the-Naze, Essex, by Mr M. R. Block, about 1949. Mr Block writes: 'Obviously something odd must have happened in the area at the time as on the same day I found floating in the sea a rare moth, the Varied Comet (*Hadena compta*), of which only half a dozen specimens had been taken in Britain before, and whose range extends eastwards to Japan.' Records of exotic shells can be misleading unless they are collected alive. For instance, Mrs A. M. BROCKBANK sent in an exotic *Meretrix* collected at Fairbourne, Merionethshire; she has since found that these shells are sold entire at a local toy shop with paper flowers inside for placing in aquaria.

Publicity. Notice of the Society's Census work was published by Mrs S. M. TURK in the November 1965 issue of the *Wild Life Observer*. Proposals for a Conchologists' Shore Directory were set out in the *Conchologists' Newsletter* No. 15, but so far these have aroused little response, only three replies having been received.

D. HEPPELL

Field Meetings

Nine field meetings were held during 1965 as follows: Sunday 28 March, Folkestone, Kent; Saturday 3 April, Norbury Park, Mickleham, Surrey; Sunday 2 May, Faversham, Kent; Sunday 16 May, Pegwell Bay, Kent; Sunday 13 June, Sidcup, Kent; Saturday 26 June, Thorsby Park, Notts.; Saturday 10 July, Bradwell-on-Sea, Essex; Sunday 15 August, Flitwick, Bedfordshire; Sunday 17 October, Wicken Fen, Cambridge.

Thanks are due to the following for leading these meetings: Messrs R. FRESCO-CORBU, D. G. PICKRELL, A. E. ELLIS, G. PITCHFORD, D. S. DAVIS, C. R. C. PAUL, Dr B. VERDCOURT and Miss J. CHATFIELD.

Details of field meetings held during the year are published in the Society's *Newsletter*.

T. PAIN

Report on Junior Membership for 1965

During the year twelve new Members joined, one resigned and one transferred from full Membership (she was still under eighteen years of age). The total Membership is now twenty-three.

The following new titles in the series *Papers for Students* were published: No. 5 'Preparation of the Radula', by Mr DONALD GLAUGHER, and No. 6 'Post-Pliocene Fossil Mollusca (Land and Freshwater)', by Mr PHILIP CAMBRIDGE.

The publication 'Biological Techniques in Colleges of Education' gave some notice of these papers and this brought in several enquiries about the series and some sales. I have records of sales up to £4 2s 0d. However, some were sold previously of which I have no record.

A Newsletter published by the Association of School Natural History Societies carried information about Junior Membership, and Mrs STELLA TURK's article 'Recording British Shells' in *Wild Life Observer* magazine also mentioned Membership in the Society. Much more could be done by a wider publicity as the results of these two mentions have shown.

H. E. J. BIGGS

Curator's Report

During 1965 more specimens of non-marine Mollusca, some of which represented new vice-county records, were kindly donated to the Society's Voucher Collection which is housed at the British Museum (Natural History). It is always useful to have records substantiated by well-labelled specimens in a collection to which present or future generations may refer. This is especially true of new vice-county records or of closely related species still under review by systematists.

JUNE E. CHATFIELD

Votes of Thanks

Votes of thanks were approved to the Trustees of the British Museum (Natural History) for the continued use of the Board Room, and to the Officers and Council of the Society.

Presidential Address

In the absence of Dr KERNEY, his address, entitled 'Distribution mapping of land and freshwater Mollusca in the British Isles—a brief history and future prospects', was delivered on his behalf by the Chairman.

Election of Officers and Council

The Officers and Council were declared elected, as shown on p. 83.

Exhibits

Mr M. R. BLOCK: live albino *Agriolimax reticulatus* (Müller).
Mrs A. M. BROCKBANK: two specimens of *Spirula spirula* (L.) taken on two occasions at the same Irish locality.
Mrs N. F. MCMILLAN: a rare leaflet on *Bulinus wrightii* by G. B. SOWERBY, 1853; an MS. 'Conchology' by SARAH KENNAWAY, dated 1810.
Mr P. E. NEGUS: British Jurassic fossil Mollusca.
Mr T. PAIN: species of *Orthalicus* from rain-forest areas of tropical South America.
Mr D. G. PICKRELL: *Pisidium moitessierianum* Paladilhe from the River Chew, a new record for Somerset North.
Mr R. P. SCASE: some morphological variations and eccentricities of molluscan shells.
Mr L. W. STRATTON: species of *Achatinella* including dextral and sinistral specimens.
Dr B. VERDCOURT: a living specimen of the Jamaican slug *Veronicella sloanii* (Cuvier) found in Co. Durham and thought to have been introduced with bananas.

NOTE: The Council of the Society decided at meetings held on 10 December 1966 and 21 January 1967 that the Proceedings of the meetings should no longer be recorded in full in the *Journal*. The Annual Reports and lists of Members Elected will, however, continue to be included.

Members Elected

830th Meeting, 19 March 1966

J. H. DUFFUS, PH.D., c/o Mrs Minton, 60 Anchorway Road, Coventry, Warwickshire.
FISHERIES LABORATORY, Remembrance Avenue, Burnham-on-Crouch, Essex.
Miss A. FULLICK, B.SC., Department of Zoology, British Museum (Natural History), Cromwell Road, London S.W.7.
Mrs J. LEACH, Ridge End, Perton, Wolverhampton, Staffordshire.
UNIVERSITY COLLEGE LIBRARY, Gower Street, London W.C.1.

831st Meeting, 16 April 1966

Mrs HAROLD G. BOGUE, 3960 Donald Street, Eugene, Oregon 97405, U.S.A.
Mrs R. B. IVIMEY-COOK, 'Kinvarra', 12a Portland Avenue, Exmouth, Devon.
LARS NORÉN, Tallgatan 6, Gnesta, Sweden.
Mrs S. P. M. WHITE, P.O. Box 1846, Mombasa, Kenya.

832nd Meeting, 21 May 1966

BRYAN CAMPBELL CLARKE, B.A., D.PHIL., Cowden Cleugh, Dalkeith, Midlothian.
JAMES X. CORGAN, Sinclair Oil & Gas Co., Box 7190, Tulsa, Oklahoma, U.S.A.
RICHARD A. DUFTON, 65 Devonport Road, London W.12.
C. B. GOODHART, M.A., PH.D., Department of Zoology, Downing Street, Cambridge.
Dr FERNANDO GHISOTTI, Via Giotto 9, Milan, Italy.
MARINE BIOLOGICAL LABORATORY, Grønnehave, Helsingør, Denmark.
NATURHISTORISKA MUSEET, Göteborg 11, Sweden.
C. P. NUTTALL, B.A., Department of Palaeontology, British Museum (Natural History), Cromwell Road, London S.W.7.
OXFORD BIOLOGICAL LABORATORY, Oxford, Maryland 21654, U.S.A.
Miss JOYCE E. RIGBY, PH.D., Department of Zoology, Queen Elizabeth College, Campden Hill Road, London W.8.
ANTHONY MARTIN SCOFIELD, B.SC., Department of Zoology, University College of North Wales, Bangor, Caernarvonshire.
RICHARD J. TURNER, 54 Robson Road, Worthing, Sussex.
MISS PATRICIA E. WEBB, M.A., Box 574, Ras Tanura District, Aramco, Dhahran, Saudi Arabia,
KENNETH R. WYE, 36 Ferry House, Big Hill, Clapton, London E.5.

834th Meeting, 12 November 1966

DENNIS BOXLEY, 78 Sherbourne Gardens, Prittlewell, Southend-on-Sea, Essex.
DAVID SEYMOUR BROWN, PH.D., Zoology Dept, University for C.H.E., Potchefstroom, South Africa.
RONALD HENRY BURRINGTON, 181 Embankment Road, Prince Rock, Plymouth, Devon.
Miss BARBARA F. CAPE, Maybury Mansions, Marylebone Street, London W.1.
J. ANTHONY CARMAN, B.A., 19 Pauls Dene Crescent, Salisbury, Wilts.
Mrs JEAN M. CATE, 12719 San Vicente Boulevard, Los Angeles, California 90049, U.S.A.
Miss FIONA JEAN CLEMENT, B.A., The Close, School Lane, Birstall, Leicester.
Miss LARCH S. GARRAD, PH.D., 21 Victoria Road, Castletown, Isle of Man.
LESLIE DAVID HARFIELD, 103 Ernest Road, Fratton, Portsmouth, Hants.
GEOFFREY H. HARPER, B.A., Magdalene College, Cambridge.
Miss CELIA JANET HONNOR, Carderock, Perrymead, Bath, Somerset.
Miss SALLY MURRELL, Monks Wood Experimental Station, Abbots Ripton, Huntingdon.
A. P. H. OLIVER, Blacklands, Crowhurst, Battle, Sussex.
ERIC G. PHILP, 6 Vicarage Close, Aylesford, Maidstone, Kent.
Mrs H. E. B. PILBROW, The Oak Cottage, Wisborough Green, Billingshurst, Sussex.
SOUTH AFRICAN MUSEUM (NAT. HIST.), The Library, P.O. Box 61, Cape Town, South Africa.
JOHN K. WHITCUTT, 665 Chepstow Road, Newport, Mon.

835th Meeting, 10 December 1966

Mrs ENID HOLE, Frogmore Farm, Bradfield, Reading, Berks.
Mrs VERA MILLS, Bridge House, Hayle, Cornwall.
LÁSZLÓ PINTÉR, Esztergom Pf. 50, Hungary.

836th Meeting, 21 January 1967

Miss SHEILA M. ANDREWS, M.A., Easton Hall Annexe, Clayton Road, Newcastle upon Tyne 2.
JOSEPH VICTOR BANNISTER, Victoria, Upper Gardens, St Julian's, Malta, G.C.
R. A. POLLARD, 212 High Street, Lewes, Sussex.
Mrs ANN G. ROBERTS, 538 Princess Drive, Liverpool 14.

Member Deceased

Dr W. D. LANG, F.R.S.

CHANGES OF ADDRESS

ARMES, Ch./T. R. W., R.A.F., 33 Hampden Way, Waddington, Lincoln.

D'ATTILIO, A., 455 Beach 139 Street, Rockaway, New York, U.S.A.

BLOCK, M. R., B.SC., Hillcrest, Heads Hill, Crookham Common, Newbury, Berks.

BURCH, J. Q., 1300 Mayfield Road, Apt 61L, Seal Beach, California 90740, U.S.A.

COPENHAGEN, UNIVERSITETETS ZOOLOGISKE MUSEUM, Universitetsparken 15, København Ø, Denmark.

CUMBERLAND, R. F., 165 Marshall Lake Road, Shirley, Solihull, Warwickshire.

DANCE, S. P., The Manchester Museum, The University, Manchester 13.

DENNISON, B. P., 24 Conway Avenue, Anchorsholme, Cleveleys, Blackpool, Lancs.

HAAS, Dr F., Field Museum of Natural History, Roosevelt Road & Lake Shore Drive, Chicago, Illinois 60605, U.S.A.

HALL, J. B., Botany Department, Wantage Hutted Site, The University, Reading, Berks.

HEPPELL, D., L.D.S., Department of Natural History, The Royal Scottish Museum, Chambers Street, Edinburgh 1.

KENNELLY, D. H., Gately House, 1 Park Gate Road, East London, South Africa.

KINLOCH, Mrs E., Predator Control Research Station, Vrolijkheid, P.O. Robertson, Cape, South Africa.

MITCHELL, G. B., M.B.E., M.A., and MITCHELL, Mrs M. J., Rockdene, Lymington Road, New Milton, Hants.

MUIRHEAD, Miss M. A. now WOTTON, Mrs M. A., 7 Buena Vista Place, Kingston 6, Jamaica.

OGILVY, I. D. S., The Lodge, Newport-on-Tay, Fife.

PAUL, C. R. C., B.A., PH.D., c/o Museum of Paleontology, University of Michigan, Ann Arbor, Michigan 48104, U.S.A.

PICKRELL, D. G., Duneln Hotel, Great George Street, Bristol.

RIVETT-CARNAC, D. C., O.B.E., B.A., Haverford, Upper Sea Road, Bexhill-on-Sea, Sussex.

SCOFIELD, A. M., B.SC., School of Agriculture, University of Nottingham, Sutton Bonington, Loughborough, Leics.

SMITH, Lt Cdr M. C. M., c/o Cdr A. J. Cooke, R.N., Chalkhurst, Eynsford, Dartford, Kent.

SOLEM, A., B.SC., M.A., PH.D., Division of Lower Invertebrates, Field Museum of Natural History, Roosevelt Road & Lake Shore Drive, Chicago, Illinois 60605, U.S.A.

TIFFIN, A. W., 95 Bouverie Road West, Folkestone, Kent.

WARD, G. T., M.A., Queen's (Upper) School, Rheindahlen, H.Q., B.A.O.R., B.F.P.O. 40.

WHITE, Miss A. R., 22 Tysoe Hill, Glenfield, Leicester.

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Hon. Sec.: Miss Joyce E. Rigby, B.Sc., Ph.D., Department of Biology,
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Authors of papers submitted for publication in the *Journal of Conchology* are urged to pay careful attention to the following notes:

1. All manuscripts submitted for publication should be sent to the Hon. Editor and not to the Hon. Secretary.

2. Manuscripts should be typed (double-spaced) on one side of the paper, leaving ample margins, and the folios numbered consecutively. Titles should be concise, and the address(es) of the author(s) indicated. Scientific names of genera and species should be underlined, authorities for specific names should be given at their first occurrence in the text. All linear measurements and weights should be in the metric system.

3. Manuscripts must be submitted in finalized, fully revised and corrected form; proof corrections are expensive and should be restricted to typographical errors. All corrections in excess of this are liable to be charged to the author. It is a function of the Editor to maintain a standard of uniformity in the presentation of papers published in the *Journal*, and authors who submit papers implicitly acquiesce in his discretion in such matters; they are recommended to study the arrangement and conventions observed in the current number. Authors should retain a carbon copy of the manuscript.

4. Text-figures must be drawn in black Indian ink, preferably on Bristol board, and numbered consecutively in arabic figures. Figures are referred to in the text as 'Fig. 1', etc.; where there is also a plate containing several figures, figures in the text are referred to as 'Text-fig. 1', etc. Lettering may be left to the Editor, in which case the information should be lightly inserted in pencil. The position of text-figures, graphs and tables should be indicated in the margin of the text. Legends for figures must be typed on a separate sheet and not on the actual illustration.

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7. References should be listed alphabetically, the author's surname and initials being given. Quote the *full* title of the paper or book. Titles of periodicals should be abbreviated according to the *World List of Scientific Periodicals* (4th edition) with the exception that the *Journal of Conchology* should be abbreviated to *J. Conch.*, and the *Journal de Conchyliologie* to *J. Conchyliol.* Where the reference is to a book, the place of publication should be added, and the publisher if a Society or Institution.

8. Authors receive 25 copies gratis of all papers other than brief notes. Further copies may be obtained at cost price if ordered when galley proofs are returned. Joint authors share reprints; they do not receive 25 copies each.

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CONTENTS

PAGE

W. O. Cernohorsky—The species of Mitridae established by H. F. Link in the Rostock Catalogue 215

M. R. Block—Some observations on *Halolimnohelix iredalei* Connolly 219

J. G. J. Kuiper—On *Pisidium pirothi* Jickeli from Lake Chad . . 225

M. J. H. Liversidge—On the distribution of *Cypraea* (*Erosaria*) *marginalis* along the east coast of Africa 229

John Bowden & David Heppell—Revised list of British Mollusca. 2. Unionacea—Cardiacea 237

Nora F. McMillan—Obituary. Robert Rendall, 1898–1967 . . 273

L. W. Stratton—Obituary. Hamilton Ernest Quick, 1882–1967 . 275

Reviews 278

Accounts for 1966 284

Proceedings: Members Elected; Annual Reports for 1966–67 . . 286

Joint Meeting: Report and Abstracts of Lectures . . . 293

Changes of Address 297

Plates 11–12

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CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

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Societies and Institutions are eligible for membership.

Meetings are held at the British Museum (Natural History), by permission of the Trustees, at 2.30 p.m., usually on the third Saturday of each month from October to May. Field Meetings are held in the summer to places of conchological interest.

Publications: The Journal of Conchology is issued, usually twice a year, and is sent free to members. It contains papers on all aspects of the subject and an annual summary of new records of British species. The *Conchologists' Newsletter* and *Papers for Students* are also published by the Society and issued free to members.

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Field Meetings *Organizer:* T. Pain, 47 Reynolds House, Erasmus Street, Millbank, London S.W.1.

Non-marine Census *Recorder:* M. P. Kerney, B.SC., PH.D., Dept of Geology, Imperial College, London S.W.7.

Marine Census *Recorder:* Mrs S. M. Turk, F.Z.S., 'Shang-ri La', Reskadinnick, Camborne, Cornwall.

Junior Membership *Officer in Charge:* Revd H. E. J. Biggs, F.L.S., 48 Park Road, Bromley, Kent.

Newsletter *Compiler:* P. E. Negus, 82 Chelsea Gardens, Chelsea Bridge Road, London S.W.1.

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Overseas members are reminded that all monies due to the Society are payable in Sterling. If payment is made in any other currency, a sufficient sum must be added to cover conversion charges imposed by the Society's bank. Devaluation of the £ has reduced costs of publications and subscriptions to overseas members, who should now remit at a rate of U.S. **$2.75 to the £.** Members who remit at the official rate of $2.40 to the £ are liable to be asked for an additional amount to cover the conversion charges.

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THE SPECIES OF MITRIDAE ESTABLISHED BY H. F. LINK IN THE ROSTOCK CATALOGUE

W. O. Cernohorsky
Vatukoula, Fiji Islands

(Read before the Society, 16 April 1966)

Heinrich Friedrich Link enumerated twenty species of Mitridae under the generic heading *Voluta* in the catalogue *Beschreibung der Naturalien-Sammlung der Universität zu Rostock*. The species of *Voluta* appear on pp. 126–128 of the 'dritte Abtheilung', published on 17 May 1807. Four of the 20 mitrid species listed by Link are Linnaean species, 7 species date from Gmelin (1791), while 9 species were introduced as new. Of these newly-established species 3 are currently accepted as valid, 3 are primary homonyms, 2 are synonyms of previously-established species, while 1 species remains a nomen dubium.

The species enumerated below are arranged according to their original sequence in Link's work. For the species established by Link, the original description [in double quotation marks] and citations of figures are given. The currently accepted name and generic position of each species is given in square brackets. The statement 'as of Linnaeus', etc., indicates that the references cited by Link correspond closely to those of the original author. An alphabetical list of all the species is given at the end.

* * *

Voluta papalis p. 127 (as of Linnaeus) [***Mitra papalis*** (L., 1758)]

The Chemnitz figures (1780: t. 147, figs. 1353, 1354) cited by Link are identical to Gmelin's (1791) citation and depict the species well.

V. stictica p. 127 [***Mitra stictica*** (Link, 1807)]

'*V. papalis β*. L.G. l.c. [p. 3459]. M.C. 4. t. 147. f. 1356.'*

The figure cited by Link represents the *Mitra stictica* of authors. *Mitra pontificalis* Lamarck, 1811, is an objective synonym. The species has an Indo-Pacific distribution; for a recent illustration see Cernohorsky (1965: pl. 14, fig. 15).

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* The following abbreviations were employed by Link: L.G. = Gmelin, 1791; M.C. = Chemnitz, 1780; Chemn.C. = Chemnitz, 1789; Schröt.Einl. = Schröter, 1783.

J. Conch. **26**: 215–218. (1968)

V. episcopalis p. 127 (as of LINNAEUS) [***Mitra mitra*** (L., 1758)]
This is a Linnaean species.

V. cardinalis p. 127 (as of GMELIN) [***Mitra cardinalis*** (Gmelin, 1791)]
This is a GMELIN species.

V. pertusa p. 127 (non L., 1758) [***Mitra imperialis*** Röding, 1798]
"Die Windungen sind gekrönt und stark abgesetzt; die Querfurchen zwischen den abgerundeten Reifen haben vertiefte Puncte. Weiss mit bräunlichen Wolken."

No figure was cited by LINK; his description, however, fits *Mitra imperialis* Röding.

V. clathrata p. 127 (non Gmelin, 1791) [nomen dubium]
"Gegitterte W[alzenschnecke]. Der vorigen ähnlich, aber ungekrönt; die Querreifen scharfkantig, durch herabgehende Streifen gekörnt, vertiefte Puncte in den Querfurchen."

LINK did not cite a reference to figures and his description of the species, which was compared to *Mitra imperialis* Röding, may possibly represent *M. ambigua* Swainson or *M. coffea* Schubert & Wagner. LINK's name is, in any case, a primary homonym of *Voluta clathrata* Gmelin (1791: 3455).

V. digitalis p. 127 [***Mitra imperialis*** Röding, 1798)]
'*V. pertusa* γ. L.G. l.c. [p. 3458]. Chemn.C. **10**. t. 151. f. 1432, 1433.'

LINK's species is an objective synonym of *Mitra imperialis* Röding.

V. spadicea p. 127 (as of GMELIN) [? ***Strigatella scutulata*** (Gmelin, 1791)]
This is a GMELIN species.

V. papilio p. 127 [***Neocancilla papilio*** (Link, 1807)]
"Schmetterlings W[alzenschnecke]. Eine schöne Art, der *V. sanguisuga* ähnlich. Gitterförmig gestreift; die erhabenen Querstreifen abwechselnd bräunlich-schwarz und weiss gefleckt, zwischen diesen eine bis zwey viel feinere gelblich weisse. Der Grund der Schale gelblich weiss. 1½ Zoll lang."

Although no figures were cited by LINK, the description is fairly graphic and applies to *Mitra sphaerulata* Martyn [non-binominal] and *M. scabriuscula* Lamarck, 1811. One could take exception to LINK's description of the spots on the spiral cords as 'brownish-black', since these spots are characteristically bluish-black or dark purple. The species has an Indo-Pacific distribution; for a recent illustration see CERNOHORSKY (1965: pl. 14, figs. 22, 22a).

V. granosa p. 127 (as of GMELIN) [***Vexillum granosum*** (Gmelin, 1791)]
This is a GMELIN species.

V. acuminata p. 127 (as of GMELIN) [species inquirenda]
This is a GMELIN species.

V. elegans pp. 127–128 (non Gmelin, 1791) [***Vexillum regina*** (Sowerby, 1828)]
"Schöne W[alzenschnecke]. . . . An unserm Exemplar sind die schwarzen Banden in der Figur braunroth, der obere Theil jeder Windung citrongelb."

'*V. plicaria* β. L.G. p. 3454. Chemn.C. **10**. t. 157. f. 1444, 1445.'

The cited CHEMNITZ figure is an extremely good representation of the species known hitherto as *Vexillum regina* (Sowerby). LINK's name, although prior to SOWERBY's *Mitra regina*, is a primary homonym of *Voluta elegans* Gmelin.

V. ornata p. 128 [nomen dubium]

"Geschmückte W[alzenschnecke]. Der vorigen ähnlich aber weniger gestreift, und die Basis nicht zurückgebogen. Jede Windung ist oben gelb, dann folgt ein braunes Band, und der untere Theil ist weiss; nahe an der Basis wechseln gelbe Felder und braune Bänder."

No figure was cited nor any locality given. TOMLIN & WINCKWORTH (1936) presumed this species to be *Vexillum taeniatum* (Lamarck, 1811), while CATE (1962) regarded LINK's description as invalid. LINK's *V. ornata* cannot possibly qualify as a nomen nudum since it is accompanied by a description—no matter how short—and thereby satisfies ICZN Article 12. LINK's description, in which he compares the species with the preceding one [= *Vexillum regina*] and mentions the 'base not recurved; each whorl with the upper region yellow, followed by a brown band and white lower part, and with alternate yellow and brown zones near the base', could equally well apply to several similar species as pointed out by CATE (loc. cit.). The species *Vexillum vulpecula* (L.) and *V. compressum* (Sowerby) both occur with the same colour-pattern as described by LINK, and it would be pure speculation to connect any of these species with LINK's description.

V. plicaria p. 128 (as of LINNAEUS) [***Vexillum plicarium*** (L., 1758)]

This is a Linnaean species.

V. caffra p. 128 (as of LINNAEUS) [***Vexillum caffrum*** (L., 1758)]

This is a Linnaean species. LINK's reference to 'M.C. **4**. t. 148. f. 2370.' should read 'f. 1370.'.

V. variabilis p. 128 [? ***Vexillum vulpecula*** (L., 1758)]

"Veränderliche W[alzenschnecke].... Aehnlich der *V. plicaria*; hat mehr, nicht so hervorstehende und scharfe Längskanten."

'M.C. **4**. t. 148. f. 1364.'

The cited CHEMNITZ figure has been referred to by GMELIN (1791) for var. β of *Voluta plicaria* L., and by LAMARCK (1811) for var. B of *Mitra corrugata* [= *Vexillum rugosum* (Gmelin, 1791)] and also for var. B of *Mitra vulpecula* (L.). The figure is indifferently executed and appears to depict one of the many variants of *Vexillum vulpecula* (L.).

Mitra variabilis Reeve, 1844, is not congeneric with *Vexillum variabilis* (Link) and thus does not enter into secondary homonymy.

V. aurantia p. 128 (as of GMELIN) [***Strigatella aurantia*** (Gmelin, 1791)]

This is a GMELIN species.

V. exasperata p. 128 (as of GMELIN) [***Vexillum exasperatum*** (Gmelin, 1791)]

This is a GMELIN species.

V. schröteri p. 128 [***Mitra schroeteri*** (Link, 1807)]

'Schröt.Einl. **1**. p. 221. t. 1. f. 13. Chemn.C. **11**. t. 179. f. 1733, 1734.'

LINK's *V. schroeteri* is the earliest valid name for the species 'Voluta cornicula schröteri' CHEMNITZ, 1795 [non-binominal], the *V. cornicula* Gmelin, 1791, *Mitra cornicula* Lamarck, 1811, and *M. cornicularis* Lamarck, 1822. Some writers have suggested that *M. schroeteri* is only a variant of *M. cornicula* (L., 1758), but the two species differ sufficiently from each other to be regarded as two separate species. The species has been reported from West Africa.

V. nigra p. 128 (as of GMELIN) [***Mitra nigra*** (Gmelin, 1791)]

This is a GMELIN species with a rather long synonymy; it is the earliest name for the species known as *Vicimitra contermina* Iredale, 1931, in Australian conchological literature.

ALPHABETICAL SUMMARY OF SPECIES INCLUDED

SPECIES	PAGE	TAXONOMIC STATUS	CURRENT USAGE
acuminata	127	GMELIN species	species inquirenda
aurantia	128	GMELIN species	*Strigatella aurantia* (Gmelin, 1791)
caffra	128	Linnaean species	*Vexillum caffrum* (L., 1758)
cardinalis	127	GMELIN species	*Mitra cardinalis* (Gmelin, 1791)
clathrata	127	homonym	nomen dubium
digitalis	127	synonym	*Mitra imperialis* Röding, 1798
elegans	127	homonym	*Vexillum regina* (Sowerby, 1828)
episcopalis	127	Linnaean species	*Mitra mitra* (L., 1758)
exasperata	128	GMELIN species	*Vexillum exasperatum* (Gmelin, 1791)
granosa	127	GMELIN species	*Vexillum granosum* (Gmelin, 1791)
nigra	128	GMELIN species	*Mitra nigra* (Gmelin, 1791)
ornata	128	nomen dubium	
papalis	127	Linnaean species	*Mitra papalis* (L., 1758)
papilio	127	valid	*Neocancilla papilio* (Link, 1807)
pertusa	127	homonym & synonym	*Mitra imperialis* Röding, 1798
plicaria	128	Linnaean species	*Vexillum plicarium* (L., 1758)
schroeteri	128	valid	*Mitra schroeteri* (Link, 1807)
spadicea	127	GMELIN species	? *Strigatella scutulata* (Gmelin, 1791)
stictica	127	valid	*Mitra stictica* (Link, 1807)
variabilis	128	synonym	? *Vexillum vulpecula* (L., 1758)

ACKNOWLEDGMENTS

Enquiries were directed to the Zoologisches Institut der Universität, Rostock, regarding the whereabouts of the molluscan collection described by LINK. Mr C. D. GABRIEL was kind enough to inform me that there is no trace of the mitrid species described by LINK under the generic name *Voluta*, although parts of this collection are extant at the Zoological Institute. Mr GABRIEL further made enquiries from the neighbouring Zoological Institute of the University at Greifswald, but LINK's molluscan specimens could not be located there either.

I should like to thank Mr C. D. GABRIEL of the Zoological Institute of Rostock University for his courteous information, and Prof. Dr L. SPANNHOF, the Director of the Zoological Institute, for permitting the enquiries to be instituted.

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J. Conch. **26**: 219–224. (1968)

SOME OBSERVATIONS ON *HALOLIMNOHELIX IREDALEI* CONNOLLY

M. R. Block
Hillcrest, Heads Hill, Crookham Common, Newbury, Berks

(*Read before the Society*, 19 *March* 1966)

As this species was described by Connolly, 1925 (*Ann. Mag. nat. Hist.* (9)**15**: 474, pl. 28, fig. 14), there is little point in giving another description here but, for the benefit of the reader who is unfamiliar with this obscure little East African snail, it could be said to bear a superficial resemblance to a half-grown *Monacha cantiana* (Müller), but it is almost quite white.

The first specimen to come into the writer's hands was sent by Mrs D. P. Irwin in August 1963, from her garden at Endebess, 7,500 feet up on Mt Elgon in western Kenya. It did not live, having been crushed in the mails. To quote Mrs Irwin's letter of that time, the snail is 'very active. . . . I always find them on grass, generally at the tip. They seem to frequent the grass under a wild fig tree at the bottom of the garden.'

Further attempts to obtain living specimens failed for various reasons until contact was made with Mr T. H. E. Jackson, naturalist and plantation owner in the same district, who in July 1965 sent the writer a score of *H. iredalei* from Kapretwa, near Kitale, presumably from a similar habitat to the last. They arrived via air mail in a dry matchbox, and were aestivating behind thin transparent epiphragms. They quickly revived when moistened, and were transferred to a glass-clear plastic sandwich box measuring 7″ × 4½″ × 3″ and containing an inch of sandy loam, some moss, leaf-mould, and a tuft of living grass (*Poa annua*). A large rectangle cut from the lid of the box and covered with nylon gauze gave adequate ventilation. The culture was kept in the bathroom in a position near to the window, but shaded from direct sunlight. Temperatures ranged from around 60° F at night to 70° F at midday. Every night at 10.30 the contents of the box were sprayed lightly with cold tap water to activate the snails, and during the next twenty-four hours the box would dry out and the snails would aestivate on the sides and top of the box.

As the first faeces produced would contain remnants of their last meal in Kenya, all the droppings left by the snails before being permanently housed were collected. These were disintegrated by gently boiling in 10% washing soda, which has the effect of intensifying the colour of any chlorophyll present without destroying anything of importance. The following were seen in the residue when examined under a low-power microscope: amorphous fine groundmass, unidentifiable; pitted wood vessels, occasionally crossed by medullary rays, typical of older stems (common); fibres typical of plant stems (occasional); fungal hyphae and apparent fungal spores (common); two small nematodes (there was no indication that these were parasitic). From these results it seemed that *H. iredalei* was a detritus feeder, possibly with a preference for fungi such as those occurring in rotten wood. This contention was not supported by direct observation of the feeding habits, for the snails greedily ate rolled oats and lettuce, but ignored mushrooms, moss, lichen, grass (dead and alive), leaf-mould and soil.

Courtship was observed on the night of 1 August, a few minutes after the snails had received their evening spray. It had the appearance of a communal affair, although it is unlikely that the spread of the mating reactions described below would occur in natural conditions. More probably the crowded state of the box and other factors interfered with normal courtship.

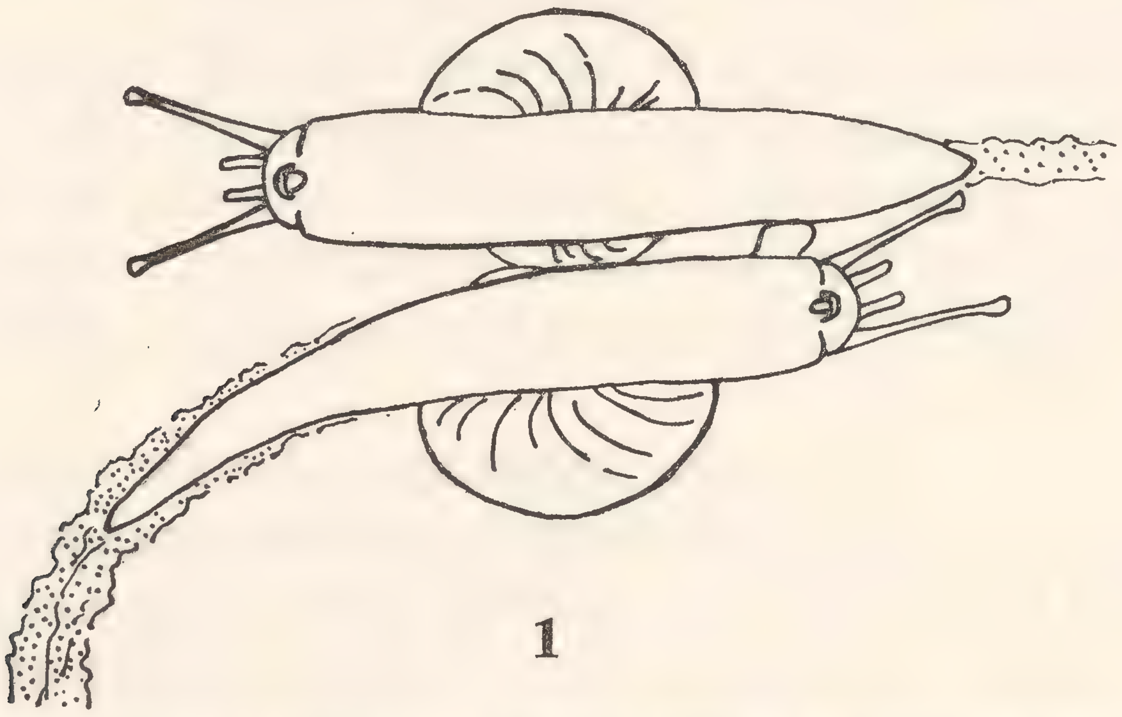

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Fig. 1. *Halolimnohelix iredalei* Connolly. Opening stages of courtship as observed through the transparent walls of the culture box. The lower snail is seen stroking the side of the upper snail with the everted atrium. (From sketches made at the time.)

A snail was seen wandering up the side of the box, secreting an unusual amount of clear slime. It turned its head from side to side as if searching for something, at the same time protruding a small white organ of roughly rhomboidal shape from the genital orifice—almost certainly this was the everted atrium. When it crossed the trail of another snail quietly feeding it followed the trail, occasionally licking it, until it reached the prospective mate. It then passed quickly along the right side of the feeding snail, brushing the side of its foot with the extended atrium and taking several bites at its body (Fig. 1). This caused the other to abandon the food and move off very quickly in an arc to the right, extending its own atrium and producing much slime.

The two snails then began to circle each other in a clockwise direction, after the manner of certain slugs, but in so doing they passed close to another individual and one turned aside to court it. This third snail was small and probably immature and did not respond to the advances of the sexually active one which, having lost its original partner, wandered away to stimulate every snail in its path. Meanwhile the deserted partner had gone off in another direction and was also stimulating other snails. In a few minutes nearly every snail in the box was either circling a partner or making advances to another. In some cases this was successful and led to copulation, but as often as not the circling pairs would cross each other's orbits and disrupt the courtship.

Several pairs were seen to copulate, but it is uncertain whether they were able to complete the process. They would circle each other four or five times in a clockwise direction, becoming progressively more thickly covered with watery slime; then, as if at a given signal, each would turn towards the centre of the circle so that the everted atria came into contact. The atria then appeared to be feeling about on each other for about half a minute, which was probably the time in which the other genitalia were brought into play. During this phase the circling slowed down to about two revolutions per minute whilst the co-copulants continued to lick or bite each other, especially about the atrial region. Occasionally one would receive an unusually severe bite, would jerk itself away and even abandon its partner, withdrawing its genitalia.

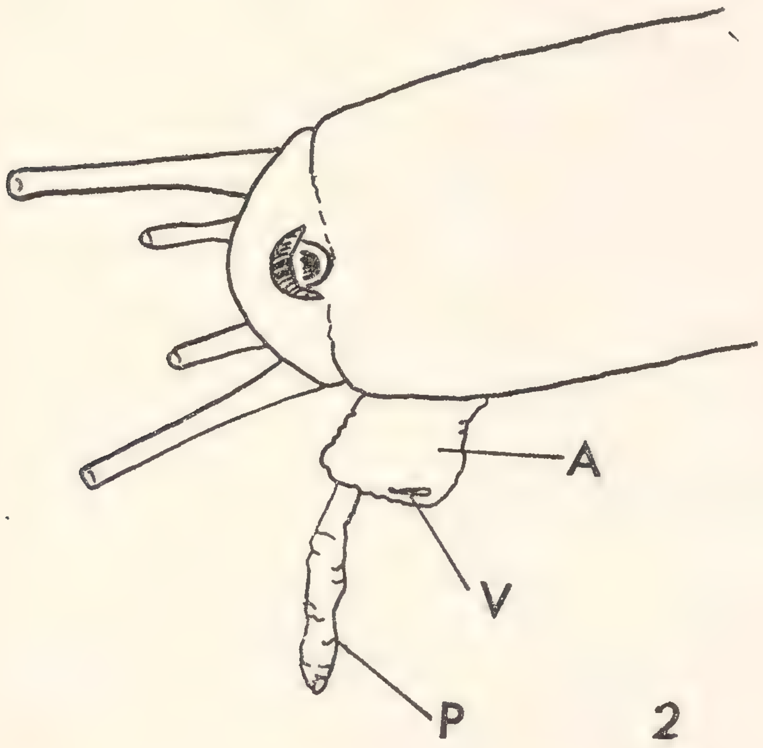

Fig. 2. Anterior end of *H. iredalei* a few seconds after copulation was ended by the partner sliding down. **A** = atrium, **P** = penis, **V** = vagina.

With the atria in contact, slime production reached its climax and in half a minute or so both snails would be so slimy as to be unable to maintain a hold on the vertical side of the box; one would slide down, the penis of each being pulled out of the vagina of the other (Fig. 2). When this happened the penis would be retracted at once and mating activity stopped. Whether the exchange of semen was completed by this time the writer cannot say, as although nearly a dozen separate copulations were observed they all took place on the slippery vertical box sides and always ended in the same way.

It is interesting to note that when the penis is retracted it collapses and shrivels back into the atrium, but is not rolled in on itself like the tentacles; the organ is, therefore, protrusible but not eversible. The anatomy of a recently mated specimen is shown in Fig. 3. The main feature of interest is the pair of small sacs at the base of the long tubular slime glands. Dr B. VERDCOURT and the writer are agreed that although they appear to be dart sacs they never contain darts. They were not seen to be everted during courtship, so their function remains obscure.

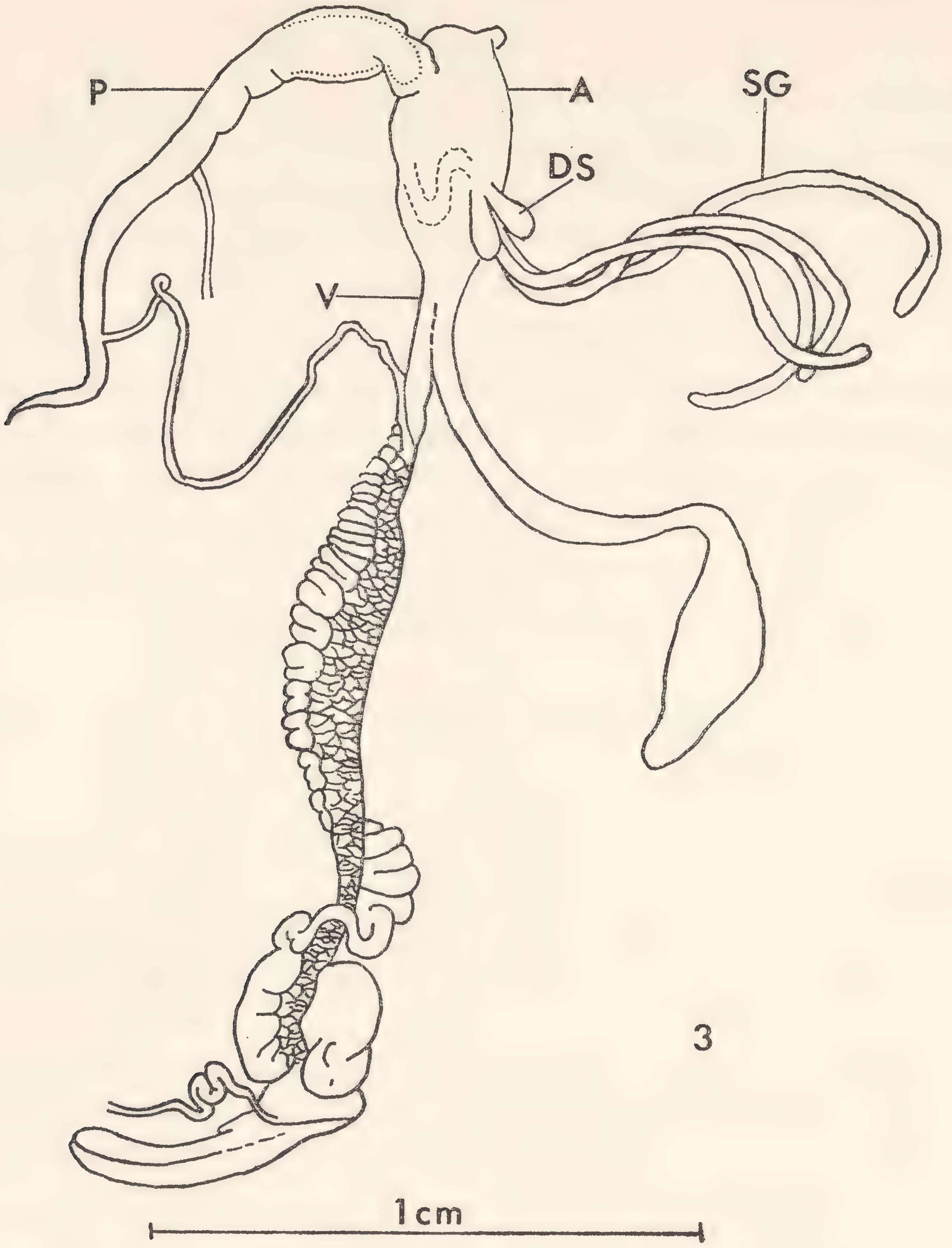

Fig. 3. Reproductive system of mature *H. iredalei* shortly after copulation, dorsal view. **A** = atrium, **DS** = pair of apparently functionless dart sacs, **P** = penis, **SG** = tubular slime glands, **V** = vagina. (Only those organs mentioned in the text have been labelled. Ovotestis lost in dissection.)

The everted atrium seems to be used as a stimulatory organ which is stroked along the side of a prospective mate. Possibly the sacs secrete a stimulating chemical which is absorbed through the skin of the snail. [Here is a subject for experiment, in which one could use *Monacha cantiana* as a substitute for *Halolimnohelix*; *M. cantiana* has the dart sac reduced to a long tube or slime gland, the egosidium, which does not form darts.]

The 'communal' mating lasted for about half an hour, after which the animals settled down to their feeding. Similar scenes were enacted on several successive nights, however, until observations were temporarily abandoned during the annual seaside holiday of two weeks. On returning home on 21 August, the writer found that several clusters of eggs had been laid in small depressions in the soil under moss and dead leaves. No attempt had been made to construct a deep subterranean chamber for them as is done by many European helicids. Owing to their small size and fragility the eggs were difficult to measure accurately, but were reckoned to be about 0·75 mm in diameter, spherical, translucent pearly white, and lacking the visible calcareous granules present in the shells of most snail eggs. They were deposited in clusters of twenty to forty, and it is thought that each snail laid more than one cluster. The hatching of later egg masses was timed, and was found to be between fifteen and eighteen days at an average temperature of 65° F—about the same as for European snail eggs at the same temperature.

The young snails left the nest in about two days (rather a short time; five days is about the usual time for helicids as recorded by the writer, but this difference may be correlated with the depth of the nest cavity). Within a week they began to die off, and experiments were begun to discover suitable conditions for them. A variety of containers was tried, with various combinations of coolness and warmth, wetness and dryness. Many different foods were offered without success. In a month all the young were dead. The parents also died a week or ten days after egg laying, so until more live material is available a suitable method of culturing *H. iredalei* cannot be devised.

A consideration of the natural habitat of *H. iredalei* would be helpful if the smaller details of the microclimate it prefers were available. It appears to be confined to the mountainous regions of western Kenya, within the area indicated on the map (Fig. 4). The specimens discussed here were taken at 7,500 ft, and other records are from similar altitudes (see list of localities below). At this height the climate is rather similar to that of a good English summer—a fairly steady 75° F during the day, falling to around 52° F at night. During the long rains from mid-July to mid-September, temperatures may fall to 62–65° F in the day and to 42° F at night. (Possibly the writer kept his specimens too warm.) Other shorter rains occur at uncertain times in March and April, and again for about ten days in November. At other times the climate is dry except for the occasional freak shower and heavy morning dews. The reproductive processes of *H. iredalei* took place in captivity in August, i.e. in the middle of the long rains, and only a few days after being collected. This is fairly certainly an annual species, reaching full growth in less than twelve months. A generous estimate of the total rainy periods would be from ten to fourteen weeks of the year, which seems too short a time for a snail to grow from egg to adult. It seems, therefore, that growth continues throughout the greater part of the dry seasons, the animals being active in the moist microclimate found under dead leaves etc., greatly assisted by heavy dews.

Dr B. Verdcourt has kindly supplied the following localities for *H. iredalei* from his extensive records of East African Mollusca. They include the minor genetic form var. *zonata* Connolly.

Uganda: N. Bugishu, Mt Elgon (G. D. Hale Carpenter).

Kenya: Mt Elgon (E. Pinhey); Mt Elgon, footslopes, Endebess (R. Tweedie); Mt Elgon, bluff above Endebess, 8,400 ft (T. Fowler); S. Kabras, Malowa Forest (E. Pinhey); Kapenguria (B. Hacker); Kabarnet Forest (D. Powell); S. end of Cherangani Hills, Cherianit Forest (C. G. Trapnell); Cherangani Hills (T. Fowler).

To the above we can add the two stations from which the subjects of this paper were obtained:

Mt Elgon, Endebess 7,500 ft (Mrs D. P. Irwin); Mt Elgon, Kapretwa (T. H. E. Jackson).

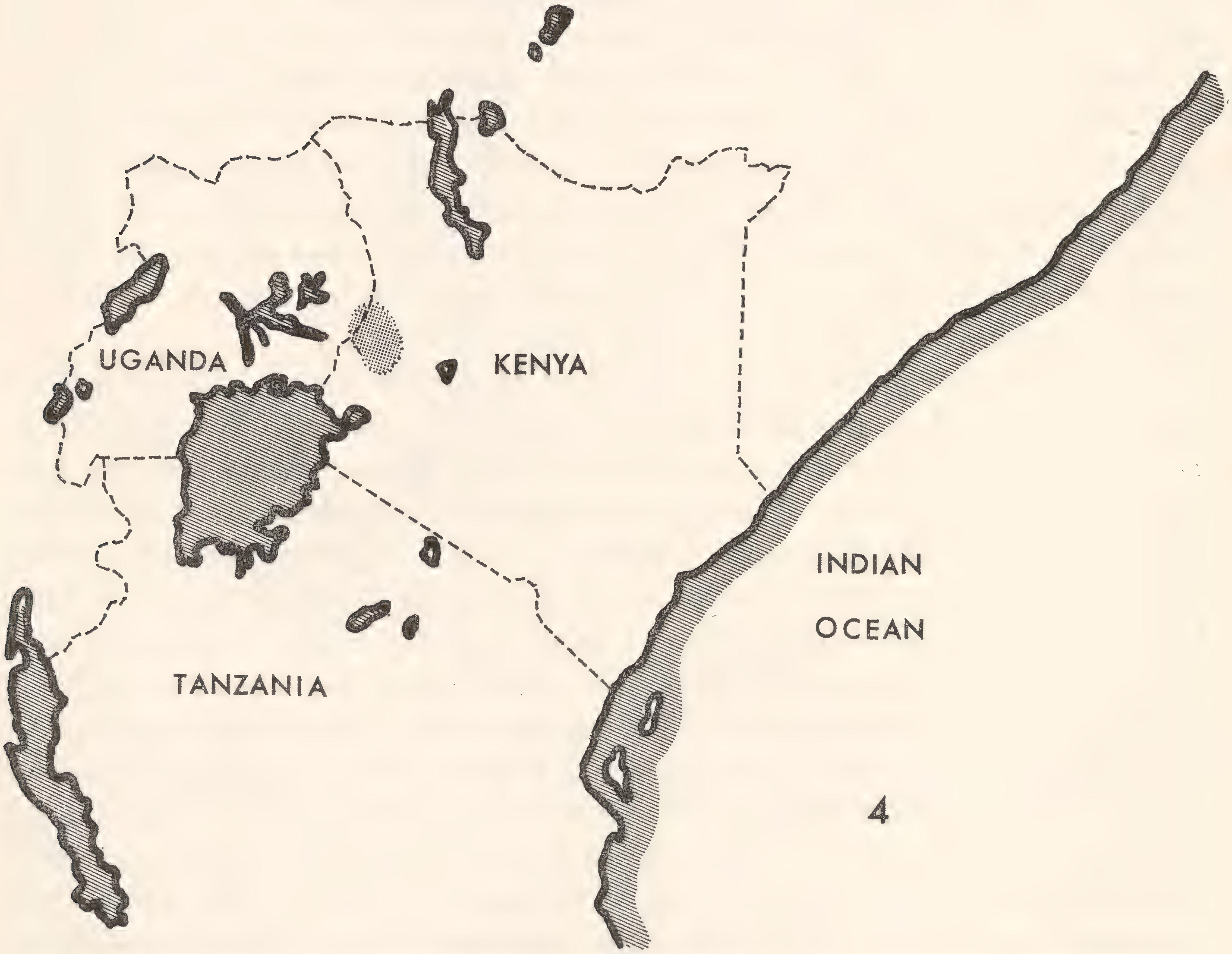

Fig. 4. Distribution of *Halolimnohelix iredalei* Connolly in East Africa (stippled area).

Acknowledgments

I should like to express my grateful thanks to Mrs D. P. Irwin and Mr T. H. E. Jackson for providing the specimens and local information on the climate of Mt Elgon, which led to the preparation of this paper; also to Dr Bernard Verdcourt for identifying the specimens, for providing the distribution map and records, and for general help and encouragement.

J. Conch. 26: 225–228. (1968)

ON *PISIDIUM PIROTHI* JICKELI FROM LAKE CHAD

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(*Read before the Society*, 19 *March* 1966)

M. Christian Lévéque of the 'Centre de Recherches Tchadiennes', Fort Lamy, Republic of Chad, sent me about 200 well-preserved *Pisidium* collected by him in 1965 at nine different points in Lake Chad. The localities are distributed over a distance of some forty miles between the Chari delta and the city of Bol, some in Cameroon and others in Chad. Two further series were taken near Fort Lamy in the Chari River which discharges into Lake Chad about sixty miles further north. All specimens proved to be *Pisidium* (*Afropisidium*) *pirothi* Jickeli (Jickeli, 1881). They were living in a sandy bottom containing vegetable matter, at depths not exceeding 3m.

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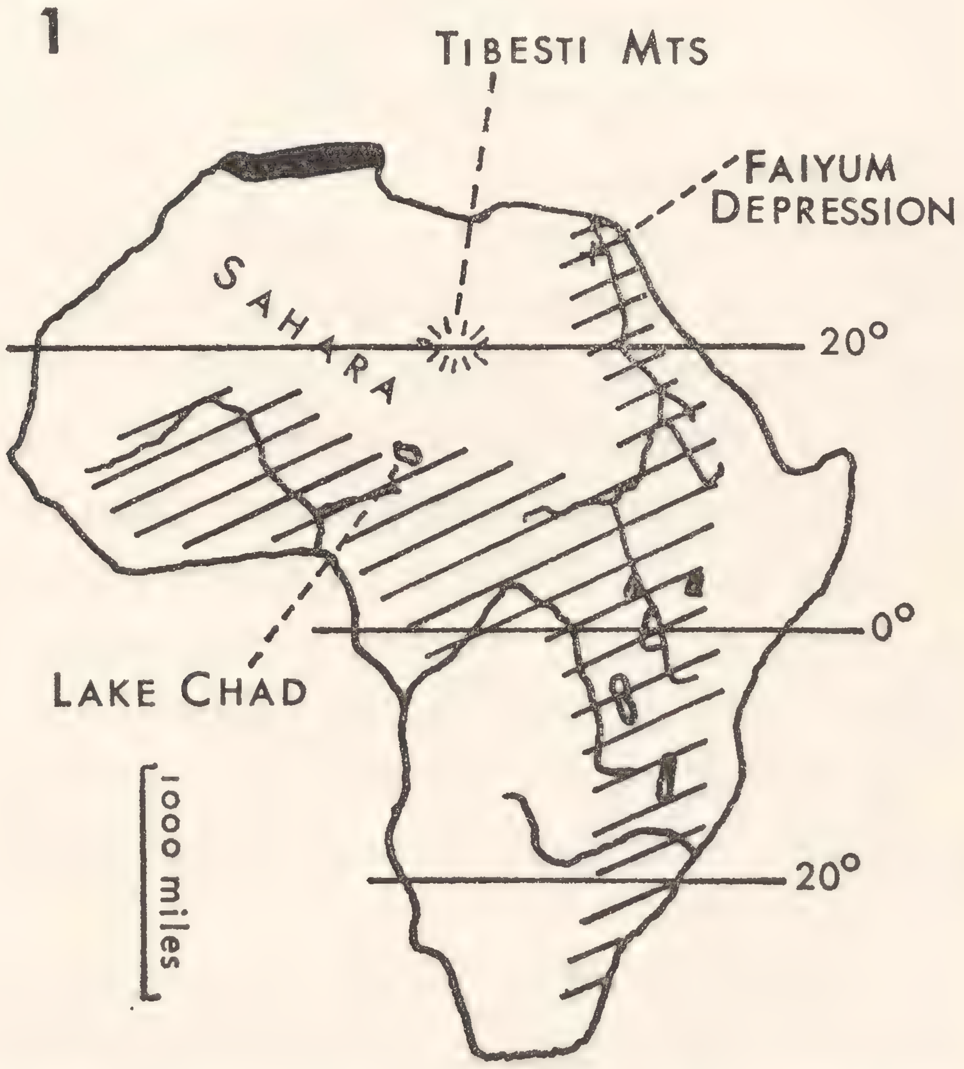

Fig. 1. Distribution of *Pisidium* (*Afropisidium*) *pirothi* Jickeli (hatched) and of *P.* (*Rivulina*) *subtruncatum* Malm (solid black).

Pisidium pirothi is an endemic African species with a wide distribution (Egypt, Sudan, Mali, Uganda, Transvaal, Natal) at lower altitudes; it is absent from high mountains (Fig. 1). It inhabits the Nile and the Niger drainage basins as well as some smaller rivers in the southern part of its range. In the Nile basin it is known from Lake Victoria and Lake Albert down to the Nile delta. It has been collected mainly in rivers, rarely in lakes. *P. victoriae* Mandahl-Barth (Mandahl-Barth, 1954) is, in my opinion, only a tiny, lacustrine form of *P.*

pirothi. The specimens of *Pisidium* recorded without specific identification by LONGSTAFF (1914: 263), taken at Gebel En and in Lake Shâmbê in the White Nile basin, also belong to *P. pirothi*. Other synonyms are '*P. casertanum* (Poli) var. *alexandrina* Pallary' from the Nile delta (PALLARY, 109: 75), '*P. clarckeanum* [sic] Nevill var. *exilis* Stelfox & Favre' from lower Egypt (FAVRE, 1943: 6), and *P. lepus* Kuiper from Transvaal (KUIPER, 1957).

Exteriorly, *P. pirothi* resembles the Palaearctic species *Pisidium* (*Rivulina*)* *subtruncatum* Malm, but its beaks are not placed so far behind and its thin, subtransparent shell is more regularly and closely striate (6–8 striae/0·5 mm in the central area of the adult shell). The hinge of *P. pirothi* is fundamentally different from that of *P. subtruncatum*. In *P. pirothi* the ligament is externally visible in profile (Fig. 2), the ligament-pit being extroverted, whereas the ligament-pit of *P. subtruncatum* is enclosed and not visible externally. Anatomically, *P. pirothi* differs from *P. subtruncatum* principally in having only one gill on each side and one siphonal aperture, whereas the latter species has two gills on each side and two siphonal apertures. The largest specimen from Lake Chad measures: L. 3·25 mm, H. 2·60 mm, D. 1·85 mm; that from the Chari River measures: L. 3·50 mm, H. 2·70 mm, D. 2·00 mm; most other specimens do not exceed 2·5 mm in length.

P. pirothi belongs to the subgenus *Afropisidium* Kuiper (KUIPER, 1962), which has a circumtropical distribution. Its African allies are *P. giraudi* Bourguignat from Lake Tanganyika and *P. fistulosum* Mandahl-Barth from Lake Victoria. Elsewhere the subgenus is represented by *P. clarkeanum* Nevill in India and Thailand (several records by Mr R. BRANDT); by *P. javanum* Jutting in Thailand, Laos (both by Mr BRANDT) and Java; by *P. hodgkini* (Suter) in New Zealand; and by *P. sterkianum* Pilsbry in South America.

P. pirothi is considerably smaller than the Asiatic *P. clarkeanum*. It differs from the latter species in the less oblique shape of its shell, its more pointed anterior side (Figs. 3, 4), its weaker ligament and finer striation. *P. clarkeanum* is not known from Africa. In my opinion the subfossil records by GARDNER (1932: 86, pl. 8, figs. 15–18) are not of *P. clarkeanum* but of *P. pirothi*. The large form figured by GARDNER (1932: pl. 8, fig. 19) may be another species. I have not seen the specimens.

The presence of *P. pirothi* in the Chad basin is interesting for other reasons. Firstly, because these recent records confirm earlier statements that this species does not live in association with other species of the genus. *P. pirothi* is now known from about thirty localities in Africa, and at each of them it was the only species of *Pisidium* collected. This specific poverty of *Pisidium* associations is characteristic of the southern hemisphere and especially of tropical regions, where associations of three species of *Pisidium* are rare. Whereas in European lakes eight species or more of *Pisidium* may be found in one locality, several tropical lakes are inhabited by only one or two species of this genus. A striking example is provided by Lake Tanganyika. I have examined several thousand valves from more than sixty stations in this 410-mile-long lake. As already stated by Leloup (1950), they all proved to belong to only one very variable species, *P. giraudi* Bourguignat.

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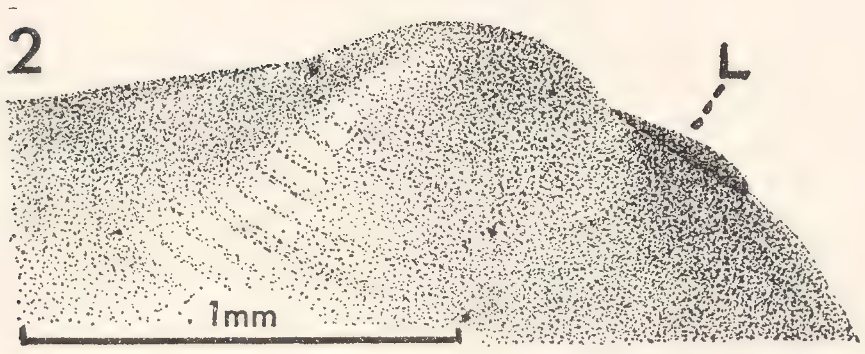
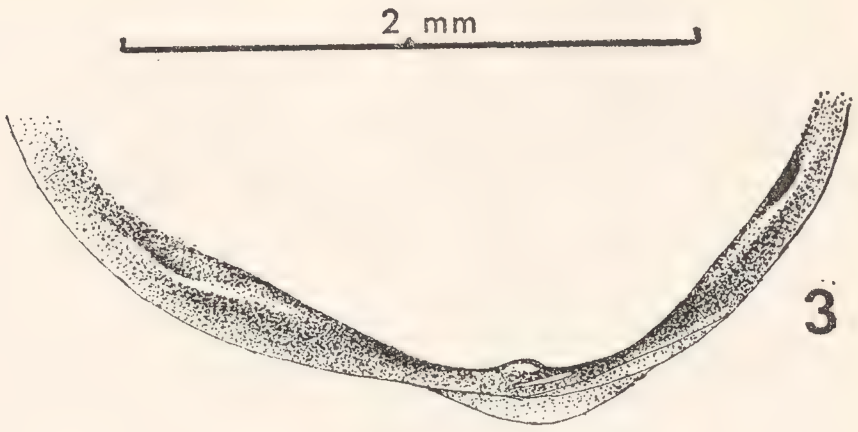
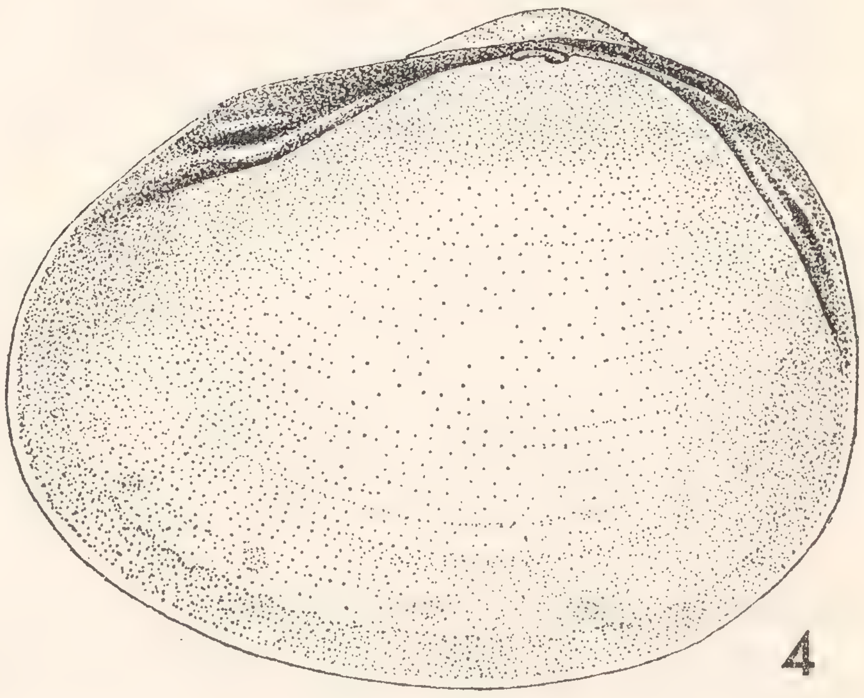
* Mr S. P. DANCE, while reading the manuscript, kindly drew my attention to the fact that *Rivulina* Clessin, 1873, is preoccupied by *Rivulina* Lea, 1850 [Gastropoda: Thiaridae]. Taking into consideration that *Fossarina* Clessin, 1873, is also preoccupied (by *Fossarina* Adams & Angas, 1863 [Gastropoda: Trochidae]), and accepting BOETTGER's (1961: 240) supposition that *Riculina* Clessin, 1874, may be a printer's error, the next name to be considered is '*Roseana*' Fagot (FAGOT, 1892: 34). As the validity of this and some other group names proposed by FAGOT is still a subject for discussion, I tentatively prefer to use *Rivulina* Clessin, 1873, for those species of *Pisidium* characterized by two gills on each side, two siphonal apertures and an enclosed ligament-pit.







Figs. 2–4. *Pisidium pirothi.* **Fig. 2.** Beak of left valve; **L** = ligament (visible externally). **Fig. 3.** Hinge of left valve. **Fig. 4.** Interior of right valve; ligament still attached to ligament-pit.

The presence of *P. pirothi* in Lake Chad is also interesting in relation to the pisidia found in the lacustrine deposits north of the lake. These subfossil pisidia do not belong, as might be expected, to *P. pirothi*, but to another species, *P. landeroini* Germain, which, in my opinion (Kuiper, 1961), is identical with the Palaearctic *P. subtruncatum* which is very common in Europe and still occurs living in northern Africa, viz in the coastal region of Algeria (Kuiper, 1964). The subfossil specimen of '*P. landeroini*' collected in the Begour Crater (Germain, 1935b) in the Tibesti Mountains, Sahara, is not *P. subtruncatum*, however, but *P. milium* Held (Kuiper, 1961). This species too still lives in the coastal region of Algeria.

In the early Holocene, Lake Chad was much larger than now, extending about 400 miles north, 200 miles east and 300 miles south-east of the present lake. This extensive, shallow lake, called the Palaeochadean Sea [Mer Paléochadienne] by the French explorer General TILHO (GERMAIN, 1935a: 397), was drained by a number of rivers which are now, with the exception of the Chari and two other rivers, nearly dry.

The subfossil molluscs collected in this former Palaeochadean Sea are mostly the same as the present species of Lake Chad (GERMAIN, 1935a; LLABADOR, 1962) but, curiously, *Pisidium subtruncatum* has been replaced by *P. pirothi*. It seems reasonable to assume that the extinction of the Palaearctic *P. subtruncatum* and the subsequent immigration of the tropical *P. pirothi* into this region happened very recently, perhaps even in historical times. Another case of recent immigration seems to be *Eupera parasitica* (Parreyss) which has been taken by M. LÉVÊQUE near the city of Bol.

The succession of these pisidia has its parallel in Egypt. GARDNER (1932) recorded '*P.* cf. *subtruncatum*' from Palaeolithic lake beds in the Faiyum Depression. Mr S. P. DANCE kindly enabled me to examine these specimens. In my opinion they, together with the specimens without appendiculum published as '*P.* cf. *henslowanum*', are *P. subtruncatum* which no longer occurs in Egypt. In the Neolithic layers of the Faiyum Depression, on the other hand, *P. subtruncatum* was absent. In its place *P. pirothi* appears (GARDNER, 1932: pl. 7, figs. 15–18 as *P. clarkeanum*). In lower Egypt *P. pirothi* is not an immigrant from Asia, as suggested by FAVRE (1943: 11), but from tropical Africa.

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J. Conch. **26**: 229–236. (1968)

ON THE DISTRIBUTION OF *CYPRAEA (EROSARIA) MARGINALIS* ALONG THE EAST COAST OF AFRICA

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(*Read before the Society*, 16 *April* 1966)

Summary

The distinct statistical difference between shells of *C. marginalis* from the extremes of the species' distribution, from Jeffreys Bay in South Africa to Aden, would appear to reveal marked morphological variations between specimens from the two areas, but latitudinal examination of the characteristics of shells collected between the two regions shows a gradual transition. This is confirmed by the inter-occurrence of the two 'subspecies' in central localities on the East African coast, indicating that *C. marginalis pseudocellata* is not a true race limited geographically, but only a variety gradually becoming more numerous from south to north.

Although as yet the details of too few specimens of *C. marginalis* from the Seychelles and Amirantes Islands have come to hand, it is clear that these shells are extreme forms of the typical *C. marginalis*, indicating that the species has been unnecessarily subdivided.

* * *

The creation in 1938 of the subspecies *Cypraea marginalis pseudocellata* (Schilder & Schilder) as a northern race of *C. marginalis* Dillwyn, 1827, and the subsequent discovery of its inter-occurrence with *C. marginalis marginalis*, raises problems of distribution and classification that may only be resolved by a systematic statistical investigation of populations from localities between the recorded limits of the two races. The contradiction of the geographical incompatibility of subspecies suggested by the occurrence of both races at common localities on the Kenya coast may indicate that possibly 'there is a cline with predominance of *marginalis* in the south and *pseudocellata* in the north, though not all specimens fit to the racial diagnoses' (Prof. F. A. Schilder, *in litt.*). While the present paper attempts to make some contribution towards clarifying the status of the two subspecies, the absence of adequate anatomical details (due to the rarity of live-collected specimens of *C. marginalis*) makes any conclusion from analysis of the shells alone tentative, although Cernohorsky (1965) has established an association of animal and shell patterns in the genus *Cypraea* which probably typifies the whole family.

The study of morphological varieties in *C. marginalis* led Schilder & Schilder (1938) to establish the subspecies *pseudocellata* for the south-east Arabian race, differing from the southern *marginalis* in its broader base with calloused and heavily pitted margins extending the entire length of the shell on both labial and columellar sides. The pronouncedly inflated elongate-ovoid shape of *marginalis* contrasts sharply with the ovoid *pseudocellata*, which also exhibits a generally steeper dorsal profile and a narrower aperture. There is little difference in tooth or fossula pattern between the races apart from individual variations which do not occur in sufficient concentrations to suggest a definite pattern: the teeth of southern specimens are slightly coarser than in *pseudocellata*, but there is no structural variation. The colouring of *pseudocellata* is richer than in the nominate subspecies, while a greater concentration of violet flecks on the base and chestnut spots on the dorsum is apparent, but this may be due to ecological conditions. Specimens from East Africa tend to exhibit characteristics intermediate between the two subspecies.

Although Allan (1956) quotes the type-locality for *C. marginalis marginalis* as South East Africa, the exact locality of the type-specimen is unknown. Schilder (1964) has suggested that Natal should be designated the type-locality, since the earliest accurate record (Krauss, 1848) is from there, under the synonym *C. listeri* Gray, 1825 (originally credited to Bengal by its author). Previous incorrect localities listed were the Red Sea and Indian Ocean (Kiener, 1845) and the Philippines (Reeve, 1845; Sowerby, 1870). The species is known to inhabit the western margins of the Indian Ocean from Jeffreys Bay to Aden and Socotra (reaching the Oman area of the Persian region—cf. Schilder & Schilder, 1938, and Schilder, 1965), where the subspecies *pseudocellata* is concentrated. In addition the species is recorded further east, from the Seychelles (Mahé) and Amirantes Islands in the Lemurian region. The most southerly record of *pseudocellata* is Shanzu, Kenya, where it was taken alive by Mrs R. S. Benton in 1961, very close to the point where Mr C. J. Metcalfe of Mombasa collected *marginalis*, also alive. Prof. F. A. Schilder has communicated to me the details of an intermediate specimen of *C. marginalis* from Mogadishu, now in the Museum at Florence, which, occurring well within the area occupied by *pseudocellata*, raises doubts as to the validity of the latter subspecies.

Naturally, a species distributed over so extensive a coastline will display considerable variation of shell characters due to ecological changes. Except where local environmental conditions may cause isolated variations, however, there is a gradual transition from the narrower specimens of *C. marginalis* from South Africa to those of Aden, as the following tables will show. The increased length of the shells from the cooler waters of the south agrees with Bergmann's rule (1847), found by Schilder (1957) to apply to cowries, which states that animals in colder zones usually attain greater size than their counterparts in warmer regions; whilst an apparent tendency towards gigantism displayed by Cypraeidae from Zanzibar would explain the difference in length between shells from the island and those from the Kenya mainland. The relative constancy of the means of labial and columellar teeth indicates that there are no significant differences in shell structure of *C. marginalis* from all localities in the region inhabited by the species.

In Table 1 the formulae of one hundred and nine specimens of *C. marginalis* from various localities along the east coast of Africa, from which the regional means in Table 2 have been calculated, are shown. In the formulae, the length of the shell (in tenths of a millimetre) is followed by the width (expressed as a percentage of the length) and the absolute number of labial and columellar teeth. In addition to the twenty typical shells sent to me by Mrs C. F. Ammundsen from a locality near Mogadishu, there are a further one hundred and forty shells, ranging in length from 16mm to 29mm, from the same beach. Although none of these was taken alive, fresh specimens, in good condition and including some juvenile shells, have been collected over several years.

Table 1

Locality	Latitude	Formula	Collection
Aden	13° N	286.66.21.18	Am. Malac. Union
		272.67.22.21	Am. Malac. Union
		234.71.19.19	Mus. Genoa
		224.70.18.17	Schilder[1]
Abd al Kuri	12° N	257.67.22.18	Schilder
Mogadishu	2° N	202.69.18.18	Mus. Florence
		235.70.20.17	Mus. Nairobi
		275.64.23.18	Mus. Nairobi
		270.60.22.18	Mus. Nairobi
		170.65.18.17	Collected by Mrs. C. Ammundsen, now in Liversidge collection.
		190.65.16.15	
		190.63.17.17	
		204.67.18.17	
		205.66.17.16	
		220.65.21.20	
		220.64.19.20	
		240.73.19.18	
		235.68.18.16	
		220.66.19.18	
		225.69.21.17	
		235.70.19.17	
		235.74.20.19	
		245.65.20.18	
		260.60.21.20	
		255.63.20.20	
		260.65.21.20	
		275.62.20.20	
		280.66.20.20	
		285.70.22.20	
Bajun Is.	2° S	258.71.18.17	Summers

[1] The holotype of *C. marginalis pseudocellata.*

Table 1 (continued)

Locality	Latitude	Formula	Collection
Shanzu	4° S	226.72.21.20	Benton (Fig. 2)
		295.64.22.19	Metcalfe
Mombasa	4° S	257.64.22.19	Am. Malac. Union
		263.64.22.21	Am. Malac. Union
		219.—.20.17	Mus. Genoa
Likoni	4° S	232.72.19.20	Mus. Nairobi
Diani	4° S	262.61.20.22	Liversidge
'Kenya'	0°–5° S	229.62.21.16	Summers
Seychelles	4° S	220.65.18.17	Bailey
		215.74.20.19	Bailey
Amirantes	6° S	190.68.17.16	Bailey
Zanzibar	6° S	250.64.24.20	Mus. Amsterdam
		240.65.20.18	Mus. Amsterdam
		284.63.19.22	Fainzilber
		308.64.25.19	Summers
		257.63.15.19	Am. Mus. Nat. Hist.
		264.65.21.19	Schilder
		233.63.23.18	Schilder
		321.63.27.25	Schilder
		288.67.23.19	Mus. Hamburg[2]
		295.62.21.16	Mus. Hamburg[2]
		236.62.23.18	Mus. Hamburg[2]
		263.60.22.19	Mus. Halle
		274.64.25.21	Mus. Halle
Moçambique	15° S	280.64.18.22	Boswell
Bazaruto Is.	22° S	300.63.20.18	Mus. East London
North Natal	29° S	274.68.—.19	Schilder
Natal	28°–31° S	320.65.23.16	Griffiths
		330.61.21.18	Natal Mus.
		270.67.19.20	Natal Mus.
		280.66.19.17	Natal Mus.
		290.62.20.19	Natal Mus.
		296.68.17.21	Burgess
		251.70.18.17	Burgess
		320.63.20.20	Mus. East London
Durban	30° S	280.68.19.16	Elston
		270.67.16.15	Elston
		266.64.17.19	Am. Mus. Nat. Hist.
		300.71.21.19	Dee
		250.68.16.15	Dee
		270.70.18.17	Dee
		279.74.18.17	Am. Malac. Union
		252.70.19.17	Burgess
		320.63.21.19	Boswell
		300.70.19.19	Boswell
		270.65.17.20	Boswell
		240.67.18.17	Boswell
		365.63.20.21	Boswell
		310.64.16.18	Boswell
		340.62.18.20	Boswell

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[2] The shells from the Hamburg Museum have all been destroyed.

Table 1 (continued)

Locality	Latitude	Formula	Collection
		230.67.19.17	Mus. Nairobi
		230.65.19.17	Mus. Nairobi
Umkomaas	30° 15′ S	260.67.16.17	Haywood
		260.65.17.17	Haywood
		330.64.22.19	Natal Mus.
		270.67.23.19	Natal Mus.
		280.64.20.18	Natal Mus.
Scottburgh	30° 20′ S	285.63.19.19	Natal Mus.
		320.67.20.22	Natal Mus.
		310.65.20.19	Natal Mus.
		350.63.24.22	S. Afr. Mus.
		240.67.19.19	S. Afr. Mus.
Port Shepstone	31° S	320.63.21.18	Natal Mus.
		295.72.20.18	Natal Mus.
South Natal	30°–31° S	250.64.21.20	Ostergaard
		282.66.20.16	Schilder
		290.67.22.19	Schilder
Umtata R.	32° S	300.63.20.18	Mus. East London
Bashee R.	32° 20′ S	300.67.20.18	Mus. East London
Kei R.	33° S	330.61.18.18	Mrs Jefferies
		380.53.20.20	Mrs Jefferies
		320.67.21.19	Griffiths
		309.61.17.18	Griffiths
Port Alfred	33° 30′ S	302.66.23.21	Mus. Vienna
Algoa Bay	33° 50′ S	326.60.26.19	Summers
		337.63.22.20	Am. Malac. Union
		328.65.22.22	Am. Malac. Union
Jeffreys Bay	34° S	330.62.22.18	Lighton
		290.66.19.19	Wicks

Table 2

Region	Latitude and Temperature		Formula	No.
Aden—Abd al Kuri	13° N–12° N	20°–25° C	255.68.21.19	5
Somalia	5° N– 0°	23°–25° C	235.67.20.18	24
Kenya	0°– 5° S	25° C	249.66.21.19	9
Zanzibar	6° S	25° C	270.67.22.19	13
Portuguese East Africa	15° S –22° S	22°–24° C	290.64.19.20	2
Durban	28° S –30° S	20°–21° C	272.64.19.18	26
South Natal	30° S –33° S	20°–21° C	300.65.20.19	25
Jeffreys Bay	33° S –34° S	18°–20° C	310.64.22.20	2
Seychelles and Amirantes [52° E –55° E]	5° S	25°–26° C	208.69.18.17	3

Table 2 illustrates the transition of specimens of *C. marginalis* between the extremities of the species' distribution by dividing into regions the localities from which the shells in Table 1 are drawn, and calculating the mean formulae for each region. The specimens from the Seychelles and Amirantes groups have been separated from those of the same latitude on the African coast, owing to their more easterly position. In the second column the average temperature of the surface of the sea in the coldest month (February or August), taken from Schilder (1965), is given with the latitude of each region. The last column shows the number of shells from which the averages have been calculated.

Prof. F. A. Schilder has shown (*in litt.*) that when the mean lengths and breadths indicated in Table 2 are plotted diagrammatically, a general negative correlation may be observed, showing that small shells are broad and large ones slender (Fig. 1). It will be seen that the specimens from the Seychelles represent an extreme at one end of the trend line, shells from Jeffreys Bay forming the extreme at the other end.

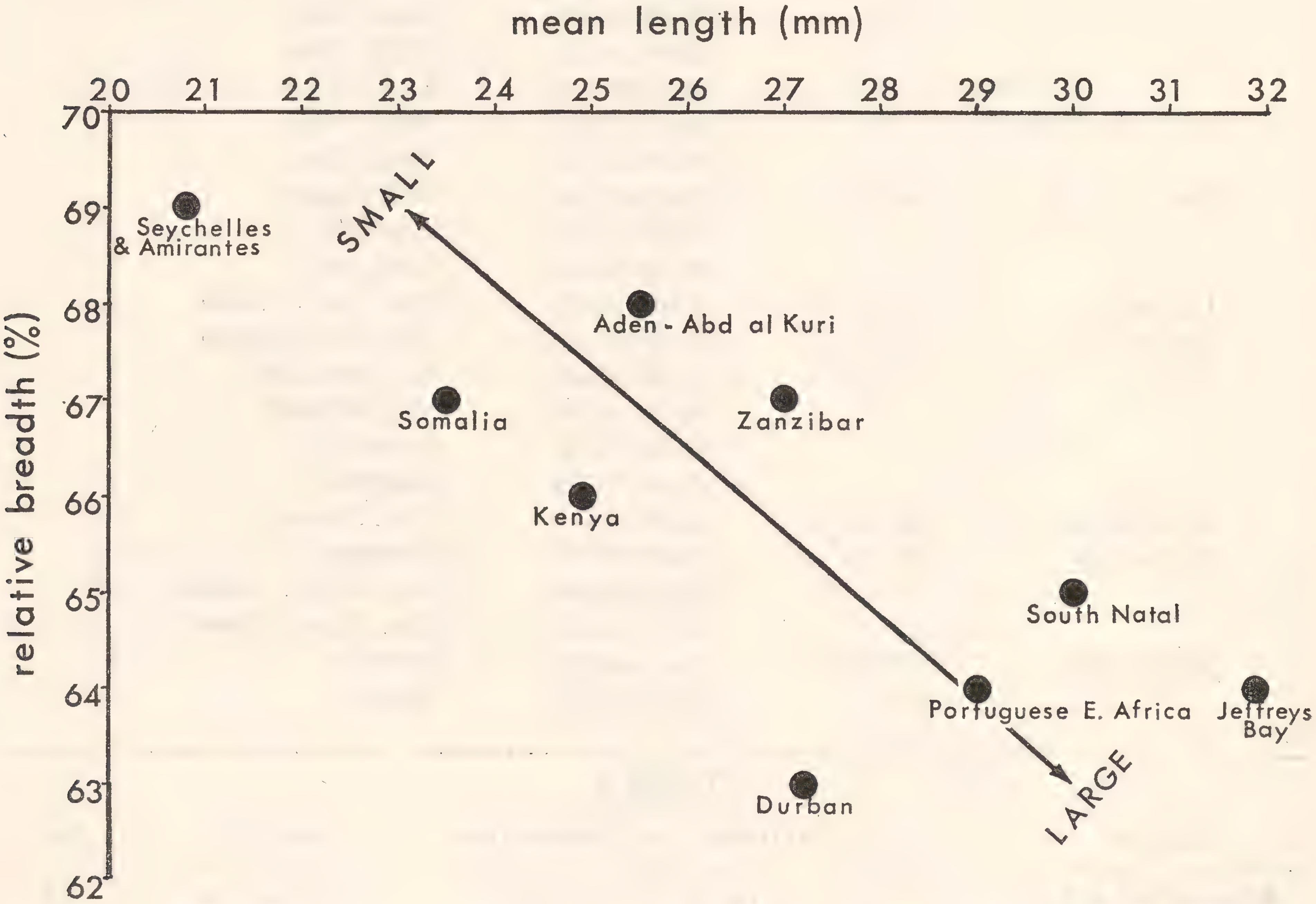

Fig. 1. Diagram to show negative correlation between mean length and relative breadth.

Although a number of live-collected shells from various localities along the African coast have been traced, only one (the specimen of *pseudocellata* found at Shanzu by Mrs R. S. Benton) has been anatomically examined by Prof. F. A. Schilder, who has kindly sent me details of the radula of the animal (Fig. 2). This is the first radula of *C. marginalis* known to science. It measures 14·5 mm in length, and is composed of 83 + 8 nascentes (total 91) rows, the median tooth being 0·126 mm broad. The radula was taken from a female specimen the shell of which, although agreeing with the holotype of *pseudocellata* in its general features, was the broadest known to Prof. Schilder.

The only description of the appearance of the living animal of *C. marginalis* I have received was from Mr E. Dee of Natal, who writes: 'The foot is very light biscuit colour tinged above with olive green spots. The mantle has long filaments, grey olive-green and tipped with lilac. The antennae are dark green at the base fading out to a light biscuit'. Two other collectors, Mr K. J. GROSCH of Moçambique, and Mrs O. R. DAVIS, who received a live specimen collected near Mogadishu, both agree that the animal of *C. marginalis* is 'rather dark'.

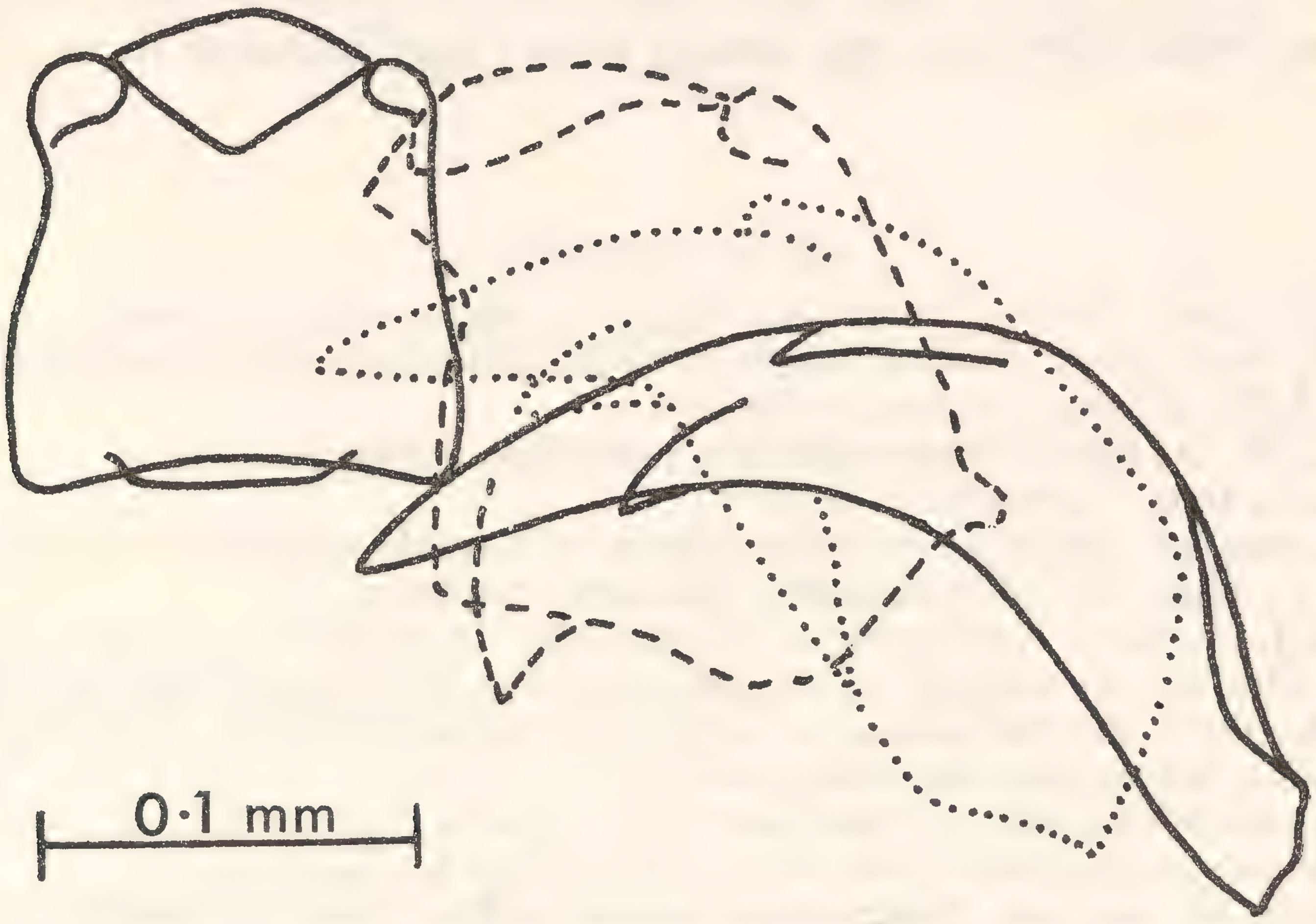

Fig. 2. *Cypraea marginalis pseudocellata* (Schilder & Schilder). Radula (no. 1109 in SCHILDER collection): right side of a central row, teeth shown in their natural position. *Del.* F. A. SCHILDER. Specimen collected at Shanzu, Kenya, 1961, by Mrs. R. S. BENTON.

——— median and second lateral   - - - - admedian   . . . . . . first lateral

The five specimens collected alive at Durban by Mr DEE were all found below rocks at depths of between two and ten feet below the low spring tide level in sheltered waters. In the same neighbourhood, Mr P. ELSTON has collected the species under rocks resting on sand in a more exposed area, conditions very similar to those in which Mrs BENTON found her shell on the outer reef at Shanzu, a few miles north of Mombasa. Mr METCALFE's specimen from the same locality was found under rotten coral at a low spring tide. The shells recorded by Mr GROSCH from Moçambique were from an area of rather muddy sand protected from heavy wave action. By contrast, the heavy concentration of dead shells from near Mogadishu, Somalia, was found on a beach where the off-shore protecting reef is interrupted. Few instances of live specimens, however, are recorded from this area, while the comparative rarity of live shells generally seems to indicate that the species may prefer deeper water. It is also possible that *pseudocellata* is an ecological variety inhabiting surf regions, but more records of live specimens are needed before an accurate idea of the habitat of *C. marginalis* may be formed.

ACKNOWLEDGMENTS

I should like to express my gratitude to Prof. F. A. SCHILDER for so kindly furnishing me with details of the animal of *C. marginalis* and allowing me to publish in this paper his figure of the first known radula; also for his generous assistance in many other ways. My thanks are also due to the many specialists and collectors who have sent me details of the specimens in their collections.

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Correction: The mean length of specimens from Jeffreys Bay is 30.9 mm, not 31.9 mm as shown in Fig. 1. The corresponding dot should therefore be moved one column to the left along the length axis, thus indicating an even more orderly progression from northern to southern specimens of *Cypraea marginalis* than that indicated in the diagram.

J. Conch. **26**: 237–272. (1968)

REVISED LIST OF BRITISH MOLLUSCA
2. UNIONACEA—CARDIACEA

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(*Read before the Society, 21 May 1966*)

SYSTEMATIC LIST
(*continued from* p. 108)

SUBCLASS PALAEOHETERODONTA (46)
ORDER UNIONOIDA
UNIONACEA

Margaritiferidae Haas, 1940 [**O. L. Name No. 202**]
Publs Field Mus. nat. Hist. (Zoology) **24**: 119.
Margaritifera Schumacher, 1816 [**O. L. Name No. 1236**]
Overs. K. danske Vidensk. Selsk. Forh. **7**: 7.
Type-species, by monotypy: *Margartifera* [sic] *fluviatilis* Schumacher, 1816 (loc. cit.) = *Mya margaritifera* L., 1758.
M. margaritifera (L., 1758) [*Mya*] [**O. L. Name No. 1456**] (47)
Systema Naturae, ed. 10 **1**: 671.
Unionidae Rafinesque, 1820 [Uniodia] [**O. L. Name No. 201**] (48)
Annls gén. Sci. phys. Brux. **5**: 290.
§ **Unioninae**
Unio Philipsson, 1788 [**O. L. Name No. 1235**]
Dissertatio hist.-nat. nova Test. Gen.: 16.
Type-species, by designation under the plenary powers: *Mya pictorum* L., 1758 [ICZN Opinion 495].
U. pictorum (L., 1758) [*Mya*] [**O. L. Name No. 1455**]
Systema Naturae, ed. 10 **1**: 671.
U. tumidus Philipsson, 1788 [**O. L. Name No. 444**]
Dissertatio hist.-nat. nova Test. Gen.: 17.
§ **Anodontinae** Swainson, 1840
Treatise Malac.: 258.
Anodonta Lamarck, 1799 [**O. L. Name No. 448**]
Mém. Soc. Hist. nat. Paris (1) **1**: 87.
Type-species, by monotypy: *Mytilus cygneus* L., 1758.

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§ ***Anodonta*** s.s. (49)

A. anatina (L., 1758) [*Mytilus*] [**O. L. Name No. 426**]
Systema Naturae, ed. 10 **1**: 706.

A. cygnea (L., 1758) [*Mytilus*] [**O. L. Name No. 429**]
Systema Naturae, ed. 10 **1** : 706.

§ ***Pseudanodonta*** Bourguignat, 1876
Bull. Soc. Sci. phys. nat. Toulouse **3**: 99.
Type-species, by selection by WESTERLUND, 1902 (*Rad jugosl. Akad. Znan. Umjetn.* **151**: 137): *Anodonta complanata* Rossmässler, 1835.

A. complanata Rossmässler, 1835 (50)
Iconographie Land- u. Süsswasser-Moll. **1**: 112.

SUBCLASS HETERODONTA (51)
ORDER CYRENODONTA
ARCTICACEA

Arcticidae Newton, 1891 [1846] (52)
Systematic List Br. Olig. Eoc. Moll.: xvii, 295.

Arctica Schumacher, 1817 (53)
Essai Hab. Vers test.: 48, 145.
Type-species, by monotypy: *Arctica vulgaris* Schumacher, 1817 (op. cit.: 145) = *Venus islandica* L., 1767.

A. islandica (L., 1767) [*Venus*]
Systema Naturae, ed. 12 **1**: 1131.

DREISSENACEA

Dreissenidae Gray, 1840 [Driessenadae] [**O. L. Name No. 76**]
In TURTON, *Manual Land & Freshw. Shells Br. Islands*, ed. 2: 277.

Dreissena Beneden, 1835 [emend. pro *Driessena*] [**O. L. Name No. 872**]
Bull Acad. r. Sci. Belg. **2**: 25.
Type-species, by monotypy: *Mytulus* [sic] *polymorphus* Pallas, 1771.

D. polymorpha (Pallas, 1771) [*Mytulus*] [**O. L. Name No. 484**]
Reise russisch. Reichs **1**: 478.

GLOSSACEA

Glossidae Gray, 1847 [1840] (54)
Proc. zool. Soc. Lond. (15): 195.

Glossus Poli, 1795
Testacea utriusque Siciliae **2**: 112.
Type-species, by monotypy: *Glossus rubicundus* Poli, 1795 (tom. cit.: 114, 253) = *Cardium humanum* L., 1758.

G. humanus (L., 1758) [*Cardium*]
Systema Naturae, ed. 10 **1**: 682.

SPHAERIACEA (55)

Sphaeriidae Jeffreys, 1862 [1820]
British Conch. **1**: 1.
Sphaerium Scopoli, 1777 [**O. L. Name No. 462**]
Introductio ad Hist. nat.: 397.
Type-species, by monotypy: *Tellina cornea* L., 1758. (56)
§ ***Sphaerium*** s.s.
S. corneum (L., 1758) [*Tellina*] [**O. L. Name No. 427**]
Systema Naturae, ed. 10 **1**: 678.
§ ***Musculium*** Link, 1807
Beschr. Nat.-Sammlung Univ. Rostock (3): 152.
Type-species, by monotypy: *Tellina lacustris* Müller, 1774.
S. lacustre (Müller, 1774) [*Tellina*] [**O. L. Name No. 431**]
Vermium terrestr. fluviat. Hist. **2**: 204.
S. transversum (Say, 1829) [*Cyclas*] [**O. L. Name No. 443**]
Disseminator of useful Knowledge **2**: 356.
§ ***Sphaeriastrum*** Bourguignat, 1854 (57)
Mém. Soc. Sci. phys. nat. Bordeaux **1** (1): 162.
Type-species, by selection by WESTERLUND, 1902 (*Rad jugosl. Akad. Znan. Umjetn.* **151**: 134): *Cyclas rivicola* Lamarck, 1818.
S. rivicola (Lamarck, 1818) [*Cyclas*] [**O. L. Name No. 438**]
Histoire nat. Anim. sans Vertèbres **5**: 558.
Pisidiidae Gray, 1857 [Pisidiadae] [**O. L. Name No. 36**]
In TURTON, *Manual Land & Freshw. Shells Br. Islands*, ed. 3: xvi.
Pisidium C. Pfeiffer, 1821 [**O. L. Name No. 809**] (58)
Naturgesch. dt. Land- u. Süsswasser-Moll. **1**: 17, 123.
Type-species, by selection by HERRMANNSEN, 1847 (*Indicis Gen. Malac.* **1**: 275): *Tellina amnica* Müller, 1774 [included by C. PFEIFFER (tom. cit.: 124) as a synonym of '*Pisidium obliquum* Lam.' = *Cyclas obliqua* Lamarck, 1818 (*Histoire nat. Anim. sans Vertèbres* **5**: 559)]. (59)
P. amnicum (Müller, 1774) [*Tellina*] [**O. L. Name No. 290**]
Vermium terrestr. fluviat. Hist. **2**: 205.
P. casertanum (Poli, 1791) [*Cardium*] [**O. L. Name No. 1713**]
Testacea utriusque Siciliae **1**: 65.
P. conventus Clessin, 1877 (60)
Malakozool. Bl. **24**: 181.
P. henslowanum (Sheppard, 1823) [*Tellina*] [**O. L. Name No. 430**]
Trans. Linn. Soc. Lond. **14** (1): 150.
P. hibernicum Westerlund, 1894 (61)
NachrBl. dt. malakozool. Ges. **26**: 205.

P. lilljeborgii Clessin, 1886 (60)
In ESMARK & HOYER, *Malakozool. Bl.* (N.F.) **8**: 119.

P. milium Held, 1836 [**O. L. Name No. 433**]
Isis **29** (4): col. 281.

P. moitessierianum Paladilhe, 1866 [**O. L. Name No. 434**]
Revue Mag. Zool. (2) **18**: 172.

P. nitidum Jenyns, 1832 [**O. L. Name No. 435**]
Trans. Camb. phil. Soc. **4** (2): 304.

P. obtusale (Lamarck, 1818) [*Cyclas*] [**O. L. Name No. 436**]
Histoire nat. Anim. sans Vertèbres **5**: 559.

P. personatum Malm, 1855
Göteborgs K. Vetensk.-o. VitterhSamh. Handl. (N.T.) **3**: 107.

P. pseudosphaerium Schlesch, 1947 (62)
Proc. malac. Soc. Lond. **27**: 138

P. pulchellum Jenyns, 1832 [**O. L. Name No. 437**]
Trans. Camb. phil. Soc. **4** (2): 306.

P. subtruncatum Malm, 1855
Göteborgs K. Vetensk.-o. VitterhSamh. Handl. (N.T.) **3**: 107.

P. supinum Schmidt, 1851 [**O. L. Name No. 441**] (63)
Z. Malakozool. **7**: 119.

P. tenuilineatum Stelfox, 1918 [**O. L. Name No. 442**] (64)
J. Conch. **15**: 296.

VENERACEA

Veneridae Rafinesque, 1815 [Veneridia] (65)
Analyse de la Nature: 146.

§ **Venerinae**

Venus L., 1758 [**O. L. Name No. 626**]
Systema Naturae, ed. 10 **1**: 645, 684.
Type-species, by designation under the plenary powers: *Venus verrucosa* L., 1758 [ICZN Opinion 195].

V. verrucosa L., 1758 [**O. L. Name No. 1**]

Circomphalus Mörch, 1853
Catalogus Conch. Yoldi **2**: 23.
Type-species, by selection by SACCO, 1900 (*Moll. Terr. Terz. Piemonte e Liguria* (28): 43): *Venus plicata* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3276) [non Barbut, 1788 (*Genera Vermium* **2**: 40)] = *Venus foliaceo-lamellosa* Dillwyn, 1817 (*Descriptive Cat. Rec. Shells* **1**: 162) [West Africa].

C. casina (L., 1758) [*Venus*] (114)
Systema Naturae, ed. 10 **1**: 685.

Clausinella Gray, 1851 (**115**)
List Br. Anim. in Coll. Br. Mus. (7): 12.
Type-species, by monotypy: *Pectunculus fasciatus* da Costa, 1778.
C. fasciata (da Costa, 1778) [*Pectunculus*]
Historia nat. Test. Britanniae: 188.

§ **Circinae** Dall, 1896 (**66**)
In Zittel, *Text-book Palaeont.* (Eastman transl.) **1**: 415.

Gouldia C. B. Adams, 1847 (**67**)
Catalogue Gen. Spec. Rec. Shells Coll. C. B. Adams: 29.
Proposed as nomen novum pro *Thetis* C. B. Adams, 1845 (*Proc. Boston Soc. nat. Hist.* **2**: 9) non J. Sowerby, 1826 (*Min. Conch. Gt Britain* **6**: 19) [fossil Veneracea].
Type-species, by selection by Dall, 1883 (*J. Conch.* **4**: 61): *Thetis cerina* C. B. Adams, 1845 (*Proc. Boston Soc. nat. Hist.* **2**: 9) [West Atlantic].
G. minima (Montagu, 1803) [*Venus*]
Testacea Britannica: 121.

§ **Pitarinae** Stewart, 1930
Spec. Publs Acad. nat. Sci. Philad. **3**: 215.

Callista Poli, 1791
Testacea utriusque Siciliae **1** Introd.: 30.
Type-species, by selection by Meek, 1876 (*Rep. U.S. geol. Surv. Terr.* **9**: 178): *Venus chione* L., 1758.
C. chione (L., 1758) [*Venus*]
Systema Naturae, ed. 10 **1**: 686.

§ **Dosiniinae** Deshayes, 1853 [Dosiniana]
Catalogue Conch. Br. Mus. (1): 3.

Dosinia Scopoli, 1777
Introductio ad Hist. nat.: 399.
Type-species, by monotypy: '*Chama dosin* Adanson' [pre-Linnaean] = *Venus concentrica* Born, 1778 (*Index Rerum Naturalium Mus. Caes. Vindobonensis*: 58) [Caribbean and SW. Atlantic]. (**68**)

§ ***Asa*** Basterot, 1825 *ex* Leach MS. (**69**)
Mém. Soc. Hist. nat. Paris (2) **1**: 90 [in synonymy sub *Cytherea lincta*].
Type-species, by monotypy: *Venus lincta* Pulteney, 1799 (*Catalogues Birds Shells Dorsetsh.*: 34) = *Venus lupinus* L., 1758
D. lupinus (L., 1758) [*Venus*]
Systema Naturae, ed. 10 **1**: 689

§ ***Pectunculus*** da Costa, 1778 (**68**)
Historia nat. Test. Britanniae: 183.
Type-species, by selection by Jukes-Browne, 1911 (*Proc. malac. Soc. Lond.* **9**: 250): *Pectunculus capillaceus* da Costa, 1778 (op. cit.: 187) = *Venus exoleta* L., 1758.

D. exoleta (L., 1758) [*Venus*]
Systema Naturae, ed. 10 **1**: 688.

§ **Tapetinae** Gray, 1851 [Tapesina]
List Br. Anim. in Coll. Br. Mus. (7): 9.

Tapes Mühlfeld, 1811
Mag. Ges. naturf. Freunde Berl. **5**: 51.
Type-species, by monotypy: *Venus literata* L., 1758 (*Systema Naturae*, ed. 10 **1**: 689) [Indo-Pacific].

§ ***Ruditapes*** Chiamenti, 1900 (70)
Riv. ital. Sci. nat. **20**: 13.
Type-species, by monotypy: *Venus decussata* L., 1758.

T. decussatus (L., 1758) [*Venus*]
Systema Naturae, ed. 10 **1**: 690.

Irus F. C. Schmidt, 1818 (71)
Versuch Einricht. Conch.-Sammlungen: 158.
Type-species, by tautonymy: *Donax irus* L., 1758 [in synonymy of *Irus rugosus* F. C. Schmidt, 1818 (loc. cit.)].

I. irus (L., 1758) [*Donax*]
Systema Naturae, ed. 10 **1**: 683.

Paphia Röding, 1798
Museum Boltenianum (2): 175.
Type-species, by selection by Dall, 1902 (*Proc. U.S. natn. Mus.* **26**: 362): *Paphia alapapilionis* Röding, 1798 (loc. cit.) = *Venus rotundata* L., 1758 (*Systema Naturae*, ed. 10 **1**: 690) [Indo-Pacific].

§ ***Polititapes*** Chiamenti, 1900
Riv. ital. Sci. nat. **20**: 11.
Type-species, by selection by Dall, 1902 (*Proc. U.S. natn. Mus.* **26**: 363): *Venus aurea* Gmelin, 1791.

P. aurea (Gmelin, 1791) [*Venus*]
Systema Naturae, ed. 13 **1**: 3288.

P. rhomboides (Pennant, 1777) [*Venus*] (72)
British Zoology, ed. 4 **4**: 83 [4to ed.], 97 [8vo ed.].

Turtonia Alder, 1848 (73)
Trans. Tyneside Nat. Club **1**: 189.
Type-species, by monotypy: *Venus minuta* Fabricius, 1780.

T. minuta (Fabricius, 1780) [*Venus*]
Fauna Groenlandica: 412.

Venerupis Lamarck, 1818
Histoire nat. Anim. sans Vertèbres **5**: 506.
Type-species, by selection by Children, 1823 (*Q. Jl Sci., Lond.* **14**:303): *Venus perforans* Montagu, 1803 (*Testacea Britannica*: 127) = *Venus saxatilis* Fleuriau de Bellevue, 1802.

V. saxatilis (Fleuriau de Bellevue, 1802) [*Venus*]
J. Phys. Chim. Hist. nat. **54**: 354.
V. senegalensis (Gmelin, 1791) [*Venus*] (74)
Systema Naturae, ed. 13 **1**: 3282.

§ **Chioninae** Frizzell, 1936 [Chionidae]
Proc. geol. Soc. Am. **for 1935**: 415.

Chamelea Mörch, 1853
Catalogus Conch. Yoldi **2**: 23.
Type-species, by selection by Bucquoy, Dautzenberg & Dollfus, 1893 (*Mollusques mar. Rousillon* **2**: 355): *Venus gallina* L., 1758.
C. gallina (L., 1758) [*Venus*] (75)
Systema Naturae, ed. 10 **1**: 685.

Mercenaria Schumacher, 1817
Essai Hab. Vers test.: 45, 135.
Type-species, by monotypy: *Mercenaria violacea* Schumacher, 1817 (op. cit.: 135) = *Venus mercenaria* L., 1758.
M. mercenaria (L., 1758) [*Venus*] (76)
Systema Naturae, ed. 10 **1**: 686.

Timoclea Brown, 1827
Illustrations Conch. Great Britain & Ireland: pl. 19, fig. 11.
Type-species, by monotypy: *Venus ovata* Pennant, 1777.
T. ovata (Pennant, 1777) [*Venus*]
British Zoology, ed 4 **4**: 83 [4to ed.], 97 [8vo ed.].

Petricolidae Orbigny, 1837 (77)
In Webb & Berthelot, *Histoire nat. Îles Canaries* **2** (2) Mollusques &c.: 109.

Petricola Lamarck, 1801
Système Anim. sans Vertèbres: 121.
Type-species, by selection by Schmidt, 1818 (*Versuch Einricht. Conch.-Sammlungen*: 55): *Venus lapicida* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3269) [Australia].

§ ***Petricolaria*** Stoliczka, 1870
Mem. geol. Surv. India, Palaeont. Indica (6) **3**: 139.
Type-species by selection by Stoliczka, 1871 (tom. cit.: xvii): *Petricola pholadiformis* Lamarck, 1818.
P. pholadiformis Lamarck, 1818
Histoire nat. Anim. sans Vertèbres **5**: 505.

Mysia Lamarck, 1818 *ex* Leach MS. (78)
Histoire nat. Anim. sans Vertèbres **5**: 543 [in synonymy sub *Lucina undata*].
Type-species, by monotypy: *Venus undata* Pennant, 1777.
M. undata (Pennant, 1777) [*Venus*]
British Zoology, ed. 4 **4**: 81 [4to ed.], 95 [8vo ed.].

ORDER LUCINODONTA

LUCINACEA (79)

Lucinidae Fleming, 1828 [Lucinadae]
History Br. Anim.: 441.

Loripes Poli, 1791
Testacea utriusque Siciliae **1** Introd.: 31.
Type-species, by monotypy: *Tellina lactea* Poli, 1791 (loc. cit.) [non L., 1758 (*Systema Naturae*, ed. 10 **1**: 676)] = *Amphidesma lucinalis* Lamarck, 1818.

L. lucinalis (Lamarck, 1818) [*Amphidesma*]
Histoire nat. Anim. sans Vertèbres **5**: 491.

Lucinella Monterosato, 1883
Naturalista sicil. **3**: 91.
Type-species, by monotypy: *Lucina commutata* Philippi, 1836 (*Enumeratio Moll. Siciliae* **1**: 32) = *Tellina divaricata* L., 1758.

L. divaricata (L., 1758) [*Tellina*] (80)
Systema Naturae, ed. 10 **1**: 677.

Lucinoma Dall, 1901
Proc. U. S. natn. Mus. **23**: 806
Type-species, by original designation (loc. cit.): *Lucina filosa* Stimpson, 1851 (*Proc. Boston Soc. nat. Hist.* **4**: 17) [Western North Atlantic].

L. borealis (L., 1767) [*Venus*]
Systema Naturae, ed. 12 **1**: 1134.

Myrtea Turton, 1822
Conchylia Ins. Brit.: xv, xxxiii, 133.
Type-species, by monotypy: *Venus spinifera* Montagu, 1803.

M. spinifera (Montagu, 1803) [*Venus*]
Testacea Britannica: 557.

Thyasiridae Dall, 1900 [1895] (81)
Trans. Wagner free Inst. Sci. Philad. **3** (5): 1116.

Thyasira Lamarck, 1818 *ex* LEACH MS. (82)
Histoire nat. Anim. sans Vertèbres **5**: 492 [in synonymy sub *Amphidesma flexuosa*].
Type-species, by monotypy: *Tellina flexuosa* Montagu, 1803.

§ ***Thyasira*** s.s.

T. croulinensis (Jeffreys, 1847) [*Clausina*]
Ann. Mag. nat. Hist. **20**: 19.

T. equalis (Verrill & Bush, 1898) [*Cryptodon*] (83)
Proc. U.S. natn. Mus. **20**: 788.

T. flexuosa (Montagu, 1803) [*Tellina*]
Testacea Britannica: 72.

Q **T. gouldii** (Philippi, 1845) [*Lucina*] (84)
Z. Malakozool. **2**: 75.

§ ***Axinulus*** Verrill & Bush, 1898
Proc. U.S. natn. Mus. **20**: 776, 790.
Type-species, by original designation (tom. cit.: 790): *Axinulus brevis* Verrill & Bush, 1898 (tom. cit.: 790) [Western North Atlantic].

T. ferruginea (Locard, 1886) [*Axinus*] (85)
Prodrome Malac. France: 466 [= *Annls Soc. Agric. Lyon* (5) **9**: 256].

Ungulinidae Adams & Adams, 1856
Genera Rec. Moll. **2**: 470.

Diplodonta Bronn, 1831 (86)
Italiens Tertiär-Gebilde: 96.
Type-species, by selection by HERRMANNSEN, 1847 (*Indicis Gen. Malac.* **1**:392): *Venus lupinus* Brocchi, 1814 (*Conchiologia foss. Subapennina* **2**: 553) [non L., 1758 (*Systema Naturae*, ed. 10 **1**: 689)] = *Tellina rotundata* Montagu, 1803 var. *aequilateralis* Cerulli-Irelli, 1909 (*Palaeontogr. ital.* **15**: 158) fide CERULLI-IRELLI, 1909 (loc. cit.). [Tertiary fossil].

Q ***D. eddystonia*** (Marshall, 1895) [*Scintilla*] (87)
J. Malac. **4**: 35.

D. rotundata (Montagu, 1803) [*Tellina*]
Testacea Britannica: 71.

GALEOMMATACEA (88)

Leptonidae Gray, 1847
Proc. zool. Soc. Lond. (15): 193.

Lepton Turton, 1822
Conchylia Ins. Brit.: xix, xxv, 61.
Type-species, by selection by HERRMANNSEN, 1847 (*Indicis Gen. Malac.* **1**: 584): *Solen squamosus* Montagu, 1803.

L. squamosum (Montagu, 1803) [*Solen*]
Testacea Britannica: 565.

Lasaeidae Gray, 1842 [Lasiadae] (89)
Synopsis Contents Br. Mus., ed. 44: 79, 91.

Lasaea Brown, 1827
Illustrations Conch. Great Britain & Ireland: pl. 20, figs. 17, 18.
Type-species, by monotypy: *Cardium rubrum* Montagu, 1803.

L. rubra (Montagu, 1803) [*Cardium*]
Testacea Britannica: 83.

Erycina Lamarck, 1805 [**O. L. Name No. 650**]
Annls Mus. Hist. nat., Paris **6** (36): 413.

Type-species, by designation under the plenary powers: *Erycina pellucida* Lamarck, 1805 (*Annls Mus. Hist. nat., Paris* **6** (37): 53) [Tertiary fossil] [ICZN Opinion 217].

§ ***Semierycina*** Cossmann, 1911 *ex* MONTEROSATO MS.

In COSSMANN & PEYROT, *Conchologie néogén. de l'Aquitaine* **1**: 547 [= *Act. Soc. linn. Bordeaux* **65**: 166].

Type-species, by original designation (loc. cit.): *Lepton prismaticum* Monterosato, 1878 (*G. Sci. nat. econ. Palermo* **13**: 68) [Mediterranean].

E. nitida (Turton, 1822) [*Lepton*] **(90)**

Conchylia Ins. Brit.: xxv, 63.

Galeommatidae Gray, 1840 [Galeommidae]

Synopsis Contents Br. Mus., ed 42: 150.

Galeomma Turton, 1825

Zool. J., Lond. **2**: 361.

Type-species, by monotypy: *Galeomma turtoni* G. B. Sowerby I, 1825.

G. turtoni G. B. Sowerby I, 1825

In TURTON, *Zool. J., Lond.* **2**: 361 footnote.

Kelliidae Forbes & Hanley, 1849 [Kelliadae]

History Br. Moll. **2**: 69.

Kellia Turton, 1822

Conchylia Ins. Brit.: xix, xxv, 56.

Type-species, by selection by RÉCLUZ, 1844 (*Revue zool.* **7**: 295): *Mya suborbicularis* Montagu, 1803. **(91)**

K. suborbicularis (Montagu, 1803) [*Mya*]

Testacea Britannica: 39, 564

K. subtrigona (Jeffreys, 1858) [*Poromya*] **(92)**

Ann. Mag. nat. Hist. (3) **1**: 42.

Montacutidae Clark, 1855

British mar. test. Moll.: 5, 94.

Montacuta Turton, 1822

Conchylia Ins. Brit.: xviii, xxv, 58.

Type-species, by selection by HERRMANNSEN, 1847 (*Indicis Gen. Malac.* **2**: 58): *Ligula substriata* Montagu, 1808.

M. substriata (Montagu, 1808) [*Ligula*] **(93)**

Testacea Britannica **Supplement**: 25

Devonia Winckworth, 1930 **(94)**

Proc. malac. Soc. Lond. **19**: 14.

Type-species, by monotypy: *Synapticola perrieri* Malard, 1904.

D. perrieri (Malard, 1904) [*Synapticola*]

Bull. Mus. Hist. nat., Paris **9**: 344.

Mysella Angas, 1877 **(95)**

Proc. zool. Soc. Lond. **for 1877**: 176.

Type-species, by monotypy: *Mysella anomala* Angas, 1877 (loc. cit.) [Australia].

M. bidentata (Montagu, 1803) [*Mya*]
Testacea Britannica: 44.

Q ***M. dawsoni*** (Jeffreys, 1864) [*Montacuta*] (96)
British Conch. **2**: 216.

M. tumidula (Jeffreys, 1866) [*Montacuta*] (95)
Ann. Mag. nat. Hist. (3) **18**: 387, 396.

Tellimya Brown, 1827 (97)
Illustrations Conch. Great Britain & Ireland: pl. 14, figs. 10–21.
Type-species, by selection by Gray, 1847 (*Proc. zool. Soc. Lond.* (15): 192): *Mya ferruginosa* [incorrectly cited by Gray as *ferruginea*] Montagu, 1808 [in synonymy of *Tellimya elliptica* Brown, 1827 (op. cit.: pl. 14, fig. 19)]. (98)

T. ferruginosa (Montagu, 1808) [*Mya*]
Testacea Britannica **Supplement**: 22.

Q ***T. phascolionis*** (Dautzenberg & Fischer, 1925) [*Montacuta*] (99)
Trav. Stn biol. Roscoff **3**: 126.

Q ***T. tenella*** (Lovén, 1846) [*Montacuta*] (100)
Index Moll. Scandinaviae: 43 [= *Öfvers. K. VetenskAkad. Förh.* **3** (6): 197].

CYAMIACEA (101)

Neoleptonidae Thiele, 1934
Handbuch systemat. Weichtierk. **2** (3): 860.

Neolepton Monterosato, 1875
Atti Accad. Sci. Lett., Palermo (N.S.) **5**: 12.
Type-species, by selection by Crosse, 1885 (*J. Conchyliol.* **33**: 140): *Lepton sulcatulum* Jeffreys, 1859.

Q ***N. obliquatum*** Chaster, 1897 (102)
Ir. Nat. **6**: 186.

N. sulcatulum (Jeffreys, 1859) [*Lepton*]
Ann. Mag. nat. Hist. (3) **3**: 34.

Arculus Monterosato, 1909
J. Conchyliol. **56**: 254.
Type-species, by monotypy: *Lepton sykesi* Chaster, 1895.

A. sykesi (Chaster, 1895) [*Lepton*] (102)
Ann. Mag. nat. Hist. (6) **15**: 248.

Epilepton Dall, 1899 (103)
Proc. U.S. natn. Mus. **21**: 876.
Type-species, by monotypy: *Lepton clarkiae* Clark, 1852.

E. clarkiae (Clark, 1852) [*Lepton*]
Ann. Mag. nat. Hist. (2) **9**: 191.

ASTARTACEA (104)

Astartidae Orbigny, 1844 [1840]
Paléontologie fr., Terrains crétacés **3**: 50.

Astarte J. Sowerby, 1816
Mineral Conch. **2**: 85 [recte 81].
Type-species, by original designation (loc. cit.): *Venus scotica* Maton & Rackett, 1807 (*Trans. Linn. Soc. Lond.* **8**: 81) = *Pectunculus sulcatus* da Costa, 1778. (105)

A. sulcata (da Costa, 1778) [*Pectunculus*]
Historia nat. Test. Britanniae: 192.

Goodallia Turton, 1822
Conchylia Ins. Brit.: xix, xxvii, 76.
Type-species, by selection by HERRMANNSEN, 1847 (*Indicis Gen. Malac.* **1**: 487): *Mactra triangularis* Montagu, 1803.

G. triangularis (Montagu, 1803) [*Mactra*]
Testacea Britannica: 99.

Tridonta Schumacher, 1817 (106)
Essai Hab. Vers test.: 49, 146.
Type-species, by monotypy: *Tridonta borealis* Schumacher, 1817.

§ ***Tridonta*** s.s.

Q ***T. borealis*** Schumacher, 1817 (107)
Essai Hab. Vers test.: 147.

T. elliptica (Brown, 1827) [*Crassina*]
Illustrations Conch. Great Britain & Ireland: pl. 18, fig. 3.

§ ***Nicania*** Leach, 1819
In Ross, *Voy. Discov. Baffin's Bay*, App. II: lxii.
Type-species, by selection by GRAY, 1847 (*Proc. zool. Soc. Lond.* (15): 194): *Nicania banksii* Leach, 1819 (loc. cit.) = *Venus montagui* Dillwyn, 1817.

T. montagui (Dillwyn, 1817) [*Venus*]
Descriptive Cat. Rec. Shells **1**: 167.
Proposed as nomen novum pro *Venus compressa*, Montagu, 1808 (*Testacea Britannica* **Supplement**: 43) non L., 1771 (*Mantissa Plantarum*: 546).

CARDIACEA

Cardiidae Lamarck, 1818 [Cardiacés] (108)
Histoire nat. Anim. sans Vertèbres **5**: 423.

§ **Cardiinae**

Acanthocardia Gray, 1851

List Br. Anim. in Br. Mus. (7): 23.

Type-species, by selection by Stoliczka, 1870 (*Mem. geol. Surv. India, Palaeont. Indica* (6) **3**: 207): *Cardium aculeatum* L., 1758. (**109**)

§ ***Acanthocardia*** s.s.

A. aculeata (L., 1758) [*Cardium*]

Systema Naturae, ed. 10 **1**: [824].

A. echinata (L., 1758) [*Cardium*]

Systema Naturae, ed. 10 **1**: 679.

§ ***Rudicardium*** Coen, 1915

Ann. Mus. civ. Stor. nat. Genova **46**: 299.

Type-species, by selection by Keen, 1937 (*Bull. Mus. r. Hist. nat. Belg.* **13** (7): 17): *Cardium tuberculatum* L., 1758.

A. tuberculata (L., 1758) [*Cardium*]

Systema Naturae, ed. 10 **1**: 679.

Plagiocardium Cossmann, 1886

Annls Soc. malac. Belg. **21**: 168.

Type-species, by selection by Sacco, 1899 (in Bellardi & Sacco, *Molluschi Terr. Terz. Piemonte e Liguria* **27**: 46): *Cardium granulosum* Lamarck, 1805 (*Annls Mus. Hist. nat., Paris* **6**: 344) [Tertiary fossil].

§ ***Papillicardium*** Sacco, 1899

In Bellardi & Sacco, *Molluschi Terr. Terz. Piemonte e Liguria* **27**: 44.

Type-species, by original designation (loc. cit.): *Cardium papillosum* Poli, 1795.

P. papillosum (Poli, 1795) [*Cardium*] (**110**)

Testacea utriusque Siciliae **2**: 56.

§ **Laevicardiinae** Keen, 1936

Proc. geol. Soc. Am. **for 1935**: 367.

Laevicardium Swainson, 1840

Treatise Malac.: 373.

Type-species, by selection by Stoliczka, 1871 (*Mem. geol. Surv. India, Palaeont. Indica* (6) **3**: xviii): *Cardium oblongum* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3254) [Mediterranean]. (**111**)

L. crassum (Gmelin, 1791) [*Cardium*]

Systema Naturae, ed. 13 **1**: 3254.

Cerastoderma Poli, 1795

Testacea utriusque Siciliae **2**: 252, 258.

Type-species, by selection by Martens, 1870 (*Zool. Rec.* **6**: 586): *Cardium edule* L., 1758.

§ ***Cerastoderma*** s.s. (**112**)

C. edule (L., 1758) [*Cardium*]

Systema Naturae, ed. 10 **1**: 681.

C. glaucum (Poiret, 1789) [*Cardium*] (**113**)

Voyage en Barbarie **2**: 13.

§ ***Parvicardium*** Monterosato, 1884

Nomenclatura gen. spec. Conch. mediterranee: 19.

Type-species, by selection by CROSSE, 1885 (*J. Conchyliol.* **33**: 140): *Cardium parvum* Philippi, 1844 (*Enumeratio Moll. Siciliae* **2**: 39) [non da Costa, 1778, nec Mawe, 1823, nec. G. B. Sowerby II, 1841] = *Cardium exiguum commutata* Bucquoy, Dautzenberg & Dollfus, 1892 (*Mollusques mar. Rousillon* **2**: 277, 282) [Mediterranean].

C. exiguum (Gmelin, 1791) [*Cardium*]

Systema Naturae, ed. 13 **1**: 3255.

C. minimum (Philippi, 1836) [*Cardium*]

Enumeratio Moll. Siciliae **1**: 51, 53.

C. ovale (G. B. Sowerby II, 1840) [*Cardium*]

Conchological Illustr. (184): catalogue p. 2.

C. scabrum (Philippi, 1844) [*Cardium*]

Enumeratio Moll. Siciliae **2**: 38.

EXPLANATORY NOTES

(*continued from* p. 122)

46. The Unionacea have usually been associated with the Trigoniacea in the order Schizodonta. After reviewing the evidence for this association, Cox (1960) concluded that the two groups have little in common. Accordingly, he assigned the Unionacea to a separate order, the Naiadida—a name modified from LAMARCK's vernacular family-group name 'les nayades'. NEWELL (1965) dissociated both the Unionacea and the Trigoniacea from the Teleodesmacea and placed them in a separate subclass, the Palaeoheterodonta, together with the Palaeozoic actinodonts. The Palaeoheterodonta 'are alike in the possession of free or incompletely fused mantle margins, an opisthodetic parivincular ligament, and prismato-nacreous shells. Posterolateral hinge teeth, where present, originate at the beaks and below the ligament.' (NEWELL, 1965: 14). At the ordinal level, NEWELL maintains COX's separation of the Unionacea from the Trigoniacea but uses the name Unionoida in place of COX's Naiadida. As the choice of names of higher taxa is determined solely by personal preference, we have adopted the name Unionoida.

47. PHILLIPS, 1928 (*Proc. malac. Soc. Lond.* **18**: 69) described a second species, *Margaritifera durrovensis*, from the river Durrow, near Nore, Co. Leix, Ireland. *M. margaritifera* normally lives in soft water (BOYCOTT, 1936: 133) and, according to HAAS (1948), *M. durrovensis* is no more than a hard water form of this species. This view appears to have been generally accepted but it must be pointed out that typical *M. margaritifera* has also been recorded from hard water (MCMILLAN, 1966).

48. Although placed on the *Official List of Family-Group Names in Zoology* as of FLEMING, 1828 (*History Br. Anim.*: 408, 415), this name was previously used by FLEMING in 1822 (*Encyclopaedia Britannica*, Suppl. to eds. 4, 5 & 6 **5**: 581) [Uniodae] as well as by RAFINESQUE in 1820.

49. A number of authors (e.g. SIMPSON, 1914; EHRMANN, 1933; HAAS, 1940) have referred the European *Anodonta* s.s. to a single very variable species, but most workers today recognize at least two species: *A. cygnea* (L.) and *A. anatina* (L.). These names have been on the *Official List of Specific Names* since 1954 [ICZN Opinion 336], but opinions have differed as to their correct application.

DODGE (1952: 218), following HANLEY (1855: 144), stated that the Linnaean *cygnea* was 'the form called *cellensis* by ROSSMÄSSLER'. A number of authors have treated this form as a distinct species* (e.g. ZHADIN, 1952: 302) or subspecies (e.g. GROSSU, 1962: 207) and, if HANLEY's identification were correct, this widely-distributed form would have to be called *cygnea* s.s. The British land and freshwater shells in the Linnaean collection in London were examined by J. W. TAYLOR and W. D. ROEBUCK in 1914, and that part of their unpublished report (dated June, 1918) concerned with *Anodonta cygnea* was quoted by BLOOMER (1938: 40): 'Two valves—one with the end broken off. Inscribed in ink "218" outside, "*cygneus*" inside, in what Dr DAYDON JACKSON considered to be certainly the handwriting of the elder LINNÉ. . . . Separated valves of one specimen referable in form to var. *cellensis* C. Pfeiffer.' Only the marked specimen, which is figured by BLOOMER (1938: pl. 2, fig. 2), can be regarded as authentic type-material (S. P. DANCE, personal communication), but the presence of a second specimen and HANLEY's presumed confusion of the two were probably the cause of DODGE's mistaken conclusion.

The specimen (usually regarded as the type) of *Mytilus anatinus* L. in the collection of the Linnean Society of London, and another in the Museum Ludovicae Ulricae in Uppsala (which collection formed a partial basis for LINNAEUS' *Systema Naturae*) are referable not to *A. anatina* auctt. but to the species commonly known as *Pseudanodonta complanata* (Rossmässler) (HANLEY, 1855: 144, pl. 2, fig. 1; BRANDER, 1956: 178, fig. 1). Thus the type-material on which this name is based is found to represent a species other than that to which the name has usually been applied. Such nomenclatural confusion can only be resolved by a decision of the ICZN. There would appear to be three possible solutions:

(i) The name *anatina* could be rejected under the plenary powers for the purposes of the Law of Priority but not for those of the Law of Homonymy. The next available name would then have to be used. Some authors have, in fact, used the name *A. piscinalis* Nilsson, 1823 (*Historia Moll. Sveciae*: 116)† for *A. anatina* auctt. non L. in the belief that it was the next available name, but ELLIS (1965) has pointed out that at least seven earlier names would have to be considered if *anatina* were rejected in its usual sense.

(ii) The name *anatina* could be strictly defined by reference to the extant type-material. *A. anatina* auctt. would then have to be called by the next available name, as in (i) above, while *Pseudanodonta complanata* (Rossmässler) would be re-named *Pseudanodonta anatina* (L.). Clearly, such a procedure would be contrary to the interests of nomenclatural stability and would only add to the confusion.

(iii) The name *anatina* could be retained in its accustomed sense by setting aside the extant type-material under the plenary powers and designating a neotype for the species.

The third of these alternatives is that preferred by the present authors. LEMCHE (1964) has proposed the designation of a neotype for *Mytilus anatinus* L. in conformity with the intentions of its entry on the *Official List*; in anticipation of a future decision by the ICZN the name *anatina* is retained here in its accustomed sense.

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* ZHADIN and GROSSU both refer the name *cellensis* to SCHRÖTER, 1779 (*Geschichte der Flussconchylien*); not only is this work non-binominal, but the name *cellensis* nowhere occurs in it! The first available name for this form is *Mytilus zellensis* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3362). The pl. 2, fig. 1 of SCHRÖTER (op. cit.), cited by GMELIN in his description, is reproduced by BLOOMER (1938: pl. 4, fig. 7). The first use of the name *cellensis*, so spelt, was as *Anodonta cellensis* C. Pfeiffer, 1821 (*Naturgesch. dt. Land- u. Süsswasser-Moll.* **1**: 110).

† For a note on the date of publication of this work see WOODWARD (1924). Whether or not WOODWARD's conclusions are justified does not affect the issue.

50. This species was formerly known in Britain as *Anodonta* (*Pseudanodonta*) *minima* Millet, 1833 (*Mém. Soc. Agric. Sci. Arts Angers* **1**: 241). BRANDER (1956), however, has shown that *Anodonta minima* Millet is not a *Pseudanodonta* but a stunted 'Bachanodonte' variety of *A. anatina* auctt. The next available name appears to be *complanata* Rossmässler.

51. We have followed NEWELL (1965) in raising the Heterodonta to a subclass distinct from the Palaeoheterodonta (see note **46**), with which they were formerly associated in the subclass Teleodesmacea. The subdivision of the heterodont superfamilies is a matter on which there is no general agreement. COX (1960) followed BERNARD (1895) and MARCH (1912) in recognizing two basic types of heterodont hinge—the 'cyrenoid' type [Pliodonta] and the 'lucinoid' type [Oligodonta] —but followed KOROBKOV (1954) in referring the Astartacea and Carditacea to a third sub-order, the Astartedonta; the Myacea he placed in a separate order Asthenodontida. KEEN (1963) based her classification of the heterodonts on that of DALL (1896). Her order Heterodontida contained four suborders, including the Asthenodontida; the Cardiacea she placed in a suborder Cyclodontida on their own, and the Veneracea she associated with the Mactracea, Solenacea and Tellinacea rather than with the Arcticacea, Glossacea and Sphaeriacea. NEWELL (1965) divided the subclass Heterodonta into three orders, of which two are represented in the Recent British fauna: (i) Veneroida (with two suborders, Lucinina (= Oligodontina + Astartedontina of Cox) and Arcticina (= Pliodontina of Cox)), and (ii) Myoida (also with two suborders, Myina and Pholadina).

A comparison of these schemes with that adopted here is shown in Table 2. Our arrangement is based on that of NEWELL, but we have used the terms Lucinodonta and Cyrenodonta of KOROBKOV (1954) in place of Lucinina and Arcticina, as they are more explicit. We have treated both these groups, as well as the Asthenodonta, as orders, and have dispensed with suborders. Only the Cyrenodonta and part of the Lucinodonta are dealt with in the present part of the Revised List.

52. Arcticidae is a junior synonym of Cyprinidae Geinitz, 1846 (*Grundriss Versteinerungsk.* **2**: 433) but, as *Cyprina* Lamarck, 1818, is a junior synonym of *Arctica* Schumacher, 1817 (see note **53**), many recent authors (e.g. NICOL, 1951a; ABBOTT, 1954: 381) have rejected Cyprinidae in favour of Arcticidae. As Cyprinidae Geinitz is, moreover, a junior homonym of Cyprinidae Rafinesque, 1815 [Cyprinia], based on *Cyprinus* L. [Pisces], we consider that the continued acceptance of Arcticidae is warranted. (See also note **54**.)

53. This genus has long been known as *Cyprina* Lamarck, 1818 (*Histoire nat. Anim. sans Vertèbres* **5**: 556). The name *Arctica* Schumacher has priority over *Cyprina*, but until 1953 it was preoccupied by *Arctica* Nozeman & Vosmaer, 1758 [Aves]. The work in which the latter name appears [*Geslachten der Vogelen*—a Dutch translation of MOEHRING's *Avium Genera* (1752)] has now been rejected for nomenclatural purposes [ICZN Opinion 241] and *Arctica* Schumacher has become available for the pelecypod.

54. The name Glossidae is a junior synonym of Isocardiidae Gray, 1840 (*Synopsis Contents Br. Mus.*, ed. 42: 150) [Isocardiadae]. As *Isocardia* Lamarck, 1799 (*Mém. Soc. Hist. nat. Paris* (1) **1**: 86), is a junior synonym of *Glossus* Poli, 1795, however, a number of authors (e.g. WINCKWORTH, 1951; NICOL, 1951b; FRANC, 1960) have rejected the name Isocardiidae in favour of Glossidae. According to ICZN Article 40(a): 'If a family-group name, changed before 1961 because of such synonymy, has won general acceptance, it is to be maintained in the interests of stability.' We consider that the name Glossidae has won sufficient acceptance to be maintained and, in accordance with Recommendation 40A, it is here cited 'with its own author and date, followed by the date of the replaced name in parentheses'.

Table 2

KEEN, 1963	COX, 1960	NEWELL, 1965	BOWDEN & HEPPELL
SC TELEODESMATA	SC HETEROCONCHIA	SC PALAEOHETERODONTA	SC PALAEOHETERODONTA
	O NAIADIDA	O UNIONOIDA	O UNIONOIDA
	UNIONACEA	UNIONACEA	UNIONACEA
O HETERODONTIDA		SC HETERODONTA	SC HETERODONTA
	O HETERODONTIDA	O VENEROIDA	
SO DIOGENODONTIDA	SO PLIODONTINA	SO ARCTICINA	O CYRENODONTA
ARCTICACEA	ARCTICACEA	ARCTICACEA	ARCTICACEA
		DREISSENACEA	DREISSENACEA
GLOSSACEA	ISOCARDIACEA	GLOSSACEA	GLOSSACEA
	CYRENACEA	CORBICULACEA	SPHAERIACEA
	→ VENERACEA	VENERACEA	VENERACEA
	SO OLIGODONTINA	SO LUCININA	O LUCINODONTA
LUCINACEA	LUCINACEA	LUCINACEA	LUCINACEA
LEPTONACEA	ERYCINACEA	LEPTONACEA	GALEOMMATACEA
CYAMIACEA		CYAMIACEA	CYAMIACEA
ASTARTACEA		→ CRASSATELLACEA	ASTARTACEA
SO CYCLODONTIDA			
CARDIACEA	CARDIACEA	CARDIACEA	CARDIACEA
SO TELEODONTIDA			
VENERACEA ←			
MACTRACEA	MACTRACEA	MACTRACEA	MACTRACEA
SOLENACEA	SOLENACEA	SOLENACEA	SOLENACEA
TELLINACEA	TELLINACEA	TELLINACEA	TELLINACEA
	SO ASTARTEDONTINA		
	ASTARTACEA ←		
SO ASTHENODONTIDA	O ASTHENODONTIDA	O MYOIDA	O ASTHENODONTA
		SO MYINA	
MYACEA	MYACEA	MYACEA	MYACEA
		GASTROCHAENACEA	GASTROCHAENACEA
		HIATELLACEA	HIATELLACEA
	O EUDESMODONTIDA	SO PHOLADINA	
PHOLADACEA	PHOLADACEA	PHOLADACEA	PHOLADACEA
SC ANOMALODESMATA		SC ANOMALODESMATA	SC ANOMALODESMACEA
O EUDESMODONTIDA		O PHOLADOMYOIDA	O ANOMALODESMATA
		SO PHOLADOMYINA	
PANDORACEA	PANDORACEA	PANDORACEA	PANDORACEA
O SEPTIBRANCHIDA	O SEPTIBRANCHIDA	O POROMYOIDA	O SEPTIBRANCHIA
POROMYACEA	POROMYACEA	POROMYACEA	POROMYACEA

SC = SUBCLASS O = ORDER SO = SUBORDER

55. Both Pisidiidae Gray, 1857, and Corbiculidae Gray, 1847 (*Proc. zool. Soc. Lond.* (15): 184) [Corbiculadae], were proposed before Sphaeriidae Jeffreys, 1862. As pointed out by Baker (1964), however, the family-group names Sphaeriidae and Sphaeriacea may be retained without transgressing the rules of priority. The oldest family-group name in this superfamily is Cycladidae Rafinesque, 1820 (*Annls gén. Sci. phys. Brux.* 5: 318) [Cycladia], with type-genus *Cyclas*,* a junior objective synonym of *Sphaerium*. Because of this synonymy the family name based on *Cyclas* has been abandoned and, as the name Sphaeriidae has become generally accepted it is to be maintained in the interests of stability [ICZN Article 40(a)], taking the date of the rejected name, of which it is to be considered the senior synonym [Article 40(b)]. Sphaeriidae accordingly takes priority as of 1820.

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* *Cyclas* Bruguière, 1798 (*Tableau encyclop. méthodique*: pl. 301); type-species, by subsequent monotypy (Lamarck, 1799. *Mém. Soc. Hist. nat. Paris* (1) 1: 84): *Tellina cornea* L., 1758.

As Sphaeriidae (based on *Sphaerium* Scopoli, 1777) is homonymous with Sphaeriidae (based on *Sphaerius* Waltl, 1838 [Coleoptera]), a ruling by the ICZN is required to avoid this homonymy.

56. On the *Official List of Generic Names* the type-species of *Sphaerium* is given as *Tellina cornea* L., 1758, by selection by GRAY, 1847 (*Proc. zool. Soc. Lond.* (15): 185). As this was the sole originally included species, however, the type is determined by monotypy.

57. *Sphaeriastrum* Bourguignat is usually dated from *Revue Mag. Zool.* (2) **6**: 668 [dated December, 1854], but BOURGUIGNAT himself stated (tom. cit.: 670) that this portion of his paper had already been published elsewhere (*Mém. Soc. Sci. phys. nat. Bordeaux* **1** (1): 155–208 [dated August, 1854] where the genus *Sphœriastrum* [sic] is proposed on p. 162. This spelling is emended in the 'Errata' to this volume [dated January, 1855] where it is stated: 'Dans tout le Mémoire de M. BOURGUIGNAT, les mots *Sphœrium* et *Sphœriastrum* doivent être écrits avec un æ et non pas avec un œ.' Although *Sphaeriastrum* was established for 'le groupe des Sphéries types' this does not constitute a type-designation according to the present Code [ICZN Article 67(c)] and thus *Sphaeriastrum* is not a junior objective synonym of *Sphaerium* s.s. [cf. the discussion on the type-species of *Eupisidium* in note **58**]. The type of *Sphaeriastrum* is commonly cited as *Sphaerium rivicola* (Lamarck) by original designation, but no such designation occurs in either of the BOURGUIGNAT papers mentioned: the earliest valid designation appears to be that of WESTERLUND.

HERRMANNSEN, 1847 (*Indicis Gen. Malac.* **2**: 275) cites the type-species of *Pisum* Mühlfeld, 1811 (*Mag. Ges. naturf. Freunde Berl.* **5**: 57) as *Cyclas rivicola* [= *S. rivicola* (Lamarck)]. If this designation were valid, *Pisum* Mühlfeld would be a senior objective synonym of *Sphaeriastrum* Bourguignat. MÜHLFELD's sole species, however, was *Pisum gallicum* [= *Tellina gallica* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3244)] and this must be the type by monotypy. The identity of this species is uncertain but, according to KENNARD & WOODWARD (1926: 300), it is either a fossil brachiopod or a rolled *Pecten* shell.

58. While Continental authors have usually recognized a number of subgenera within the genus *Pisidium*, most British authors have kept the genus undivided. Clearly some division is desirable, but in view of the nomenclatural confusion and taxonomic uncertainty which presently exists the publication of an acceptable classification of the British species has not been possible. We have thought it opportune, however, to elucidate which names are available and to which groups of species they are applicable; it is hoped that the notes presented here will form a useful basis for further discussion. The systematics of the genus were investigated by BOETTGER (1961) who recognized three subgenera, *Pisidium* s.s., *Neopisidium* and *Galileja*. It is convenient to use this arrangement as a framework for the present detailed consideration of the question.

(i) *Pisidium* s.s.

P. amnicum is the only Recent British species retained in the restricted subgenus *Pisidium* s.s. The Pleistocene fossil *P. clessini* Neumayr (= *P. astartoides* Sandberger) also belongs to this group which is distinguished by the shell being strongly striate or ribbed.

(ii) *Neopisidium*

Neopisidium Odhner, 1921 (*J. Conch.* **16**: 222); type-species, by selection by HABE, 1951 (*Genera Jap. Shells* (2): 114): *Pisidium torquatum* Stelfox, 1918 (*J. Conch.* **15**: 299) = *P. moitessierianum* Paladilhe, 1866. The species of this group are distinguished by the presence of a single siphonal aperture and a single pair of demibranchs. The British species included are *P. conventus*, *P. moitessierianum*, *P. tenuilineatum* and the Pleistocene and Post-glacial fossil *P. vincentianum*.* KUIPER (1962a) considered that the species referred to *Neopisidium* were a heterogeneous assemblage; on the basis of the position of the ligament he recognized three subgenera: *Odhneripisidium* (in which he later (KUIPER, 1962c) placed *Pisidium tenuilineatum*), characterized by introverted chondrophores; *Afropisidium*, characterized by extroverted chondrophores and a projecting external ligament; and *Neopisidium* for the restricted group of remaining species. While noting the marked differences among the members of this residual group, and in particular between *P. moitessierianum* and *P. conventus*, he did not further split the genus. The heterogeny of *Neopisidium* is further discussed by KUIPER (1966c: 9) and it appears that the continued usage of the name, except in a very restricted sense, has little justification; even the character of the demibranchs is not constant as *P. casertanum* (normally having two pairs) has been reported (KUIPER, 1966c: 11) with but a single pair.

(iii) *Galileja*

The majority of European pisidia (i.e. those not placed in *Pisidium* s.s. or *Neopisidium*) were included by BOETTGER (1961) in the subgenus *Galileja* O. G. Costa, 1840.† The species in this group have normally two pairs of demibranchs and two siphonal apertures. According to WOODWARD (1913: 2, 31), the type-species (*G. tenebrosa*) is identical with *Pisidium casertanum* (Poli). KUIPER (1962a: 55, 57; 1964), however, has shown that WOODWARD's synonymy is incorrect and that *Galileja* and *G. tenebrosa* are nomina dubia. BOETTGER (1964) defended WOODWARD's claim that *G. tenebrosa* and *P. casertanum* are synonymous. The evidence for this supposed identity seems, at most, circumstantial; specimens of *P. casertanum* have indeed been obtained from the type-locality of *G. tenebrosa*, but in the absence of authentic type-material, and taking into consideration the conflicting views on the value of COSTA's description and figures, we remain in accord with KUIPER's conclusions. A full discussion of the identity of *Galileja tenebrosa* has been presented by KUIPER (1964), who gives reasons for believing the type-locality to be erroneous and the genus to be marine.

As *Galileja* is unavailable as a subgenus of *Pisidium*, a valid name for this group of species must be determined. The following names, which are here dealt with in chronological order, require consideration: *Pera*, *Euglesa*, *Cordula*, *Cycladina*, *Rivulina*, *Fossarina*, *Riculina*, *Pusillana*, *Roseana*, *Amnicana*, *Casertiana*, *Henslowiana*, *Cyclocalyx*, *Cymatocyclas*, *Tropidocyclas* and *Eupisidium*.

Pera G. B. Sowerby II, 1842, *ex* LEACH MS. (*Conchological Manual*, ed. 2: 221). The type-species, by monotypy, is *Tellina amnica* Müller, 1774, and *Pera* must, therefore, be considered a junior objective synonym of *Pisidium* s.s., notwithstanding the inclusion of five other species under that name when the LEACH MSS. were published posthumously by GRAY in 1852.

Euglesa Leach, 1852 (*Synopsis Moll. Great Britain*: 291). *Euglesa* contained the sole species *E. henslowiana* which is thus the type by monotypy. BOETTGER (1961: 240) considered this to be a synonym of *Tellina henslowana* Sheppard, but he was almost certainly in error. According to KUIPER (1962a: 57) the name is a nomen dubium, and that is the view accepted here.‡

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* KUIPER (1962b) has shown that *P. vincentianum* Woodward, 1913 (*Catalogue Br. spp. Pisidium in Br. Mus. nat. Hist.*: 6, 127) is synonymous with *P. stewarti* Preston, 1909 (*Rec. Indian Mus.* 3: 116). As the name *vincentianum* has been placed on the *Official List of Specific Names* [Name No. 445], however, it should be used in preference to *stewarti*, despite the priority of the latter, by any zoologist who accepts the synonymy of the two names. *P. stewarti* is the type-species, by original designation, of *Odhneripisidium* Kuiper, 1962 (*J. Conchyliol.* **102**: 55).

† Erroneously cited by WOODWARD (1913) and BOETTGER (1961) as '*Galileia*', but corrected by BOETTGER (1962: 65). The occurrence of the name in the *Correspondenza Zoologica* (1839: 181) is a nomen nudum (WOODWARD, 1913: 2). The correct reference is *Fauna Sicilia* (Moll.): 1; type-species, by monotypy: *Galileja tenebrosa* O. G. Costa, 1840 (loc. cit.).

‡ JENYNS (1832: 302) included *Euglesa henslowiana* Leach MS. in the synonymy of his *Pisidium pusillum* (= *Tellina pusilla* Turton, 1819, non Gmelin, 1791) = *P. personatum* Malm, and this synonymy has been accepted by most later British authors. SHEPPARD, when he established the name *Tellina*

Cordula Leach, 1852 (*Synopsis Moll. Great Britain*: 292), contained the sole species *C. amnica* = *Tellina amnica* Müller, 1774, and is thus, like *Pera*, a junior objective synonym of *Pisidium* s.s.

Cycladina Clessin, 1871 (*Malakozool. Bl.* **18**: 189; type-species, by selection by Boettger (1961: 237): *Pisidium nitidum* Jenyns, 1832) is preoccupied by *Cycladina* Cantraine, 1835 [Galeommatacea].*

Rivulina Clessin, 1873 (in Westerlund, *Fauna Moll. Sveciae*: 532; type-species, by selection by Clessin, 1874 (in *Systematisches Conch.-Cab.*, ed. Küster (Lief. 228): 8): *Pisidium supinum* Schmidt, 1851) is preoccupied by *Rivulina* Lea, 1851 [Gastropoda]. In spite of this preoccupation, *Rivulina* Clessin has been widely used.

Fossarina Clessin, 1873 (in Westerlund, *Fauna Moll. Sveciae*: 535; type-species, by selection by Clessin, 1874 (in *Systematisches Conch.-Cab.*, ed. Küster (Lief. 228): 8): *Cyclas obtusalis* Lamarck, 1818) is preoccupied by *Fossarina* Adams & Angas, 1864 [Gastropoda].

Riculina Clessin, 1874 (*Mitt. Ver. Naturfreunde Reichenberg* **5**: 50) is considered by Boettger (1961) to be a typographical error for *Rivulina* Clessin, 1873. As such it has no separate status in nomenclature and cannot be used as a replacement name [ICZN Article 32(c)].

Fagot (1892) introduced the names *Pusillana*, *Roseana*, *Amnicana*, *Casertiana* and *Henslowiana*. Although these have been regarded by some authors as validly proposed names in the genus-group they are in fact names given to secondary subdivisions of a genus and, as such, have no nomenclatural status [Article 42(d)]. These names must be attributed to the first author who elevated them to subgeneric rank, but no subsequent author appears to have regarded them as of more than infrasubgeneric rank.†

Cyclocalyx Dall, 1903 (*Proc. biol. Soc. Wash.* **16**: 7). This too was proposed as a section of a subgenus and has no nomenclatural status as of this date and authorship.

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henslowana, expressly attributed it to Leach MS. This seems to have been a reference to *Pera henslowiana* Leach MS. and not to *Euglesa henslowiana*, however, for Jenyns (1832: 308–309) remarks, when referring to *Pisidium henslowanum* (Sheppard) (with which he synonymizes '*Pera Henslowiana*, Leach (olim)'): 'The discovery of this . . . species is likewise due to Professor Henslow . . . Dr Leach named it after him; but subsequently changed the name to that of *Pera appendiculata*, reserving the above specific name for another and larger shell. This last having however since proved to be a mere variety of the following [*P. amnicum*], I have restored the name of *Henslowianum* to the present species, which has already been described under that title by the Rev. R. Sheppard . . .'. It thus seems likely that the name *Pera henslowiana* was originally applied by Leach to the species now known as *Pisidium henslowanum* (Sheppard) but was later transferred to a variety of *P. amnicum*. *Euglesa henslowiana* was a distinct species and possibly synonymous with *P.personatum*. Kuiper (1962a: 57), however, considered Leach's description of *E. henslowiana* to be more applicable to a species of *Sphaerium* than to a *Pisidium*, but the true identity of the species can only be determined by examination of the type-series, if any such can be recognized.

* Cycladina Latreille, 1825 (*Familles nat. Règne anim.*: 218) is not used in a generic sense, but is a latinization of 'Cycladines', Latreille's third family of bivalves which included the genera *Cyclas*, *Cyprina*, *Galathea* and *Cyrena*. Cycladina Berthold, 1827, is similarly used (p. 209) in the German edition of this work.

† The system of generic subdivision followed by Fagot is outlined by Bourguignat (1860: 61–63). Genera were divided into 'sections' (= subgenera), the names of which were formed by the addition of *-astrum* to the generic stem (e.g. *Sphaeriastrum*); the sections were divided into 'groups', the names of which were formed by the addition of *-ana* to the stem of the 'type-species' (e.g. *Amnicana* from *Pisidium amnicum*). Identically named groups could occur in different genera, for instance *Pusillana* Fagot, 1891, is based on *Vertigo pusilla* while *Pusillana* Fagot, 1892, is based on *Pisidium pusillum*. The page-references for Fagot's *Pisidium* groups, which all appear in *Explors pyrén.* **27**, are as follows: p. 33 *Pusillana*, p. 34 *Roseana*, p. 35 *Casertiana* and *Amnicana*, p. 36 *Henslowiana*. The page-references given by Boettger (1961) for the new names attributed to Fagot differ from those given here, as Boettger was working from a re-paginated separate. The '*Bull. Soc. Ramond*' cited by Boettger and in Neave's *Nomenclator Zoologicus* is an alternative title for the '*Explors pyrén.*'. Favre (1943) used the names *Amniciana* [sic], *Casertiana* and *Henslowiana*, attributing them to Bourguignat, 1865. He did not give a reference to Bourguignat's establishment of these names, unfortunately, and we have not been able to trace it. It is probable that Favre's reference is to an MS. usage only.

Cymatocyclas Dall, 1903 (*Proc. biol. Soc. Wash.* **16**: 7; type-species, by original designation (loc. cit.): *Pisidium compressum* Prime, 1851) and *Tropidocyclas* Dall, 1903 (loc. cit.; type-species, by original designation (loc. cit.): *Tellina henslowana* Sheppard, 1823). These appear to be the first validly introduced subgeneric names for the '*Galileja*' group of species. As both were published simultaneously the relative priority of *Cymatocyclas* and *Tropidocyclas* must be determined by the action of the first reviser [Article 24(a)]. If this subgenus, like *Neopisidium*, should be considered heterogeneous, both these names are available, as are a number of later names not considered here. Kuiper (1963: 251) has already stated, for example, that he considers *Pisidium lilljeborgii*, *P. supinum* and *P. henslowanum* to be quite distinct from *P. milium*, *P. nitidum* and *P. subtruncatum*.

With the exception of Boettger (1961), those recent authors who have advocated the division of *Pisidium* into three subgenera have adopted either *Rivulina* Clessin, 1873, or *Eupisidium* Odhner, 1921,* as the name of the third subgenus. As shown above, *Rivulina* Clessin is preoccupied and therefore invalid. *Eupisidium*, although apparently available (see footnote), is considerably junior to Dall's *Cymatocyclas* and *Tropidocyclas*.

The taxonomic problems involved in any subdivision of the genus are ably summed up by Kuiper (*in litt.*): 'There is, at the actual level of our knowledge of the subgeneric division of *Pisidium*, still too much hypothesis. For a limited area we are able to construct a more or less satisfactory subdivision, but as soon as we confront this system with species from other continents, we feel its inadequacy and the arbitrariness of the subgeneric characters chosen. As a matter of fact, we have not much advanced in this respect during the last hundred years. And even the character of the gills—what is its systematic value? Odhner has suggested in one of his earlier papers the possibility of polyphyletic development within the group of neopisidia. Well, I think that *Neopisidium* Odhner may be the result of such a heterogeneous development. . . . The more I meditate on this question the more I am convinced that we can only proceed to an acceptable subgeneric division not earlier than when all species of *Pisidium* of the world are known.'

59. The type-species of *Pisidium* is given on the *Official List of Generic Names* as *Tellina amnica* Müller 'by selection by Gray (J. E.), 1847 (*Proc. zool. Soc. Lond.* (15): 185)'. Gray, however, merely included *Pisidium* in the synonymy of *Pisum* when citing a type-species for *Pisum*, and that does not constitute a type-designation for *Pisidium* under the present Code. Herrmannsen validly designated *Tellina amnica* as the type-species later in the same year.

60. *Pisidium urinator* Clessin, 1876 (*Bull. Soc. vaud. Sci. nat.* **24**: 236) is probably a senior synonym of *P. conventus*, but the whereabouts of the type-series is unknown. The question has been discussed by Kuiper (1966b) who recommended that the name *urinator* should be suppressed as a threat to nomenclatural stability. Earlier authors had followed Odhner (1923) in believing *P.*

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* *Eupisidium* Odhner, 1921 (*J. Conch.* **16**: 222) was proposed in contradistinction to the subgenus *Neopisidium* to comprise 'the species with two gills on each side and two siphonal openings'. By implication this would include the species *Pisidium hibernicum*, *P. personatum* and *P. pusillum* Woodward [= *P. nitidum* Jenyns] which are the only species in Odhner's paper not referred to *Neopisidium*. If these are considered to be the originally included species, the type-species of *Eupisidium* is *Pisidium personatum* Malm, by selection by Odhner, 1940 (*Ark. Zool.* **32A** (11): 3). As the name *Eupisidium* was not actually associated with any nominal species in Odhner's paper, however, it is also arguable that *Eupisidium* should be treated as a genus caelebs, in which case the type-species is *Pisidium personatum* Malm by subsequent monotypy (Odhner, 1923. *Proc. malac. Soc. Lond.* **15**: 155, 159). Boettger (1961: 233; 1962: 64) has argued that as the stated characteristics of *Eupisidium* (two gills and two siphonal openings) do not distinguish this subgenus from *Pisidium* s.s., *Eupisidium* must be regarded as a synonym of *Pisidium* s.s. Even if it was Odhner's intention, however, to include all pisidia with two gills and two siphonal apertures, the Code states [Article 42 (b)] that 'each taxon of the genus-group is objectively defined only by reference to its type-species'. As *Pisidium amnicum* was not an included nominal species it cannot qualify for consideration for type-species. Accordingly, Boettger's conclusions in this matter appear to us to be untenable.

urinator to be synonymous with *P. lilljeborgii*, a viewpoint which Kuiper (loc. cit.) showed to be most unlikely.

61. Boettger (1961) considered this species to be a junior synonym of *Pisidium parvulum* Clessin. Kuiper (1965), however, after examining the type-series of *P. parvulum*, agreed with Woodward's (1913) view that it is a composite of four species, and recommended that a lectotype be selected to make the name a junior synonym of *P. obtusale* (Lamarck). Herrington (1962) included *P. hibernicum* in the synonymy of *P. ferrugineum* Prime but, according to Kuiper (1966a), the two species are quite distinct.

62. There is as yet no general agreement as to the authorship of the name *P. pseudosphaerium*, which has been variously ascribed to Favre (1927), Ehrmann (1933), Jutting & Kuiper (1942), Altena (1945) and Schlesch (1947).

Favre (1927: 294) used the term 'pseudo-sphaerium' only in a general sense to describe the ecologically-determined, depauperate 'mode' of any species of *Pisidium* living in an uncongenial habitat, and having a thin shell and a superficial resemblance to a small *Sphaerium*. He used this term with reference not only to *P. milium*, but also to *P. casertanum*, *P. personatum*, *P. obtusale* and *P. nitidum*. Moreover, as he applied it only to a 'mode', which is clearly an infrasubspecific grouping, Favre's usage can have no status in nomenclature.

Boettger (1962: 65) attributed the name to Ehrmann (1933: 241). This author, however, merely listed a 'f. *pseudosphaerium* Favre' under *P. milium* without listing a corresponding 'forme' for other species. As pointed out by Kuiper (1962d: 183), Ehrmann's failure to list a 'f. *pseudosphaerium*' for other species cannot be held to affect the status of the 'f. *pseudosphaerium*' of *P. milium*.

Jutting & Kuiper (1942: 59) described and figured '*Pisidium milium* Held var. *pseudosphaerium* Favre'. Schlesch (1947: 140) considered this usage to be a valid description establishing the name *pseudosphaerium* as a variety of *P. milium*, and after raising the variety to specific rank he called it *P. pseudosphaerium* Jutting & Kuiper. Kuiper (1962d) upheld this attribution of authorship. [Kuiper (1962d: 184) gives the date as '1947'; this is evidently a typographical error, however, as the page-reference given is correct for the 1942 paper.]

Schlesch, however, was not the first to elevate the name to specific rank. Altena (1945: 139) had already done so two years earlier and, indeed, Ellis (1962: 50) called the species '*P. pseudosphaerium* (Favre) Altena'. Kuiper (1962d: 184), however, pointed out that it is not clear from Altena's citation which '*pseudosphaerium* Favre' was intended, and that his usage must therefore be considered a nomen nudum with no status in nomenclature. Ellis (1963) accordingly altered his view and now maintains that authorship must be ascribed to Schlesch (1947).

Kuiper (1947) called this species *P. favrei*, and placed all the pre-1947 usages cited above in its synonymy. Schlesch's paper, however, appeared while Kuiper's was in press, and in a footnote (1947: 35) Kuiper acknowledged the priority of '*Pisidium pseudosphaerium* Jutting & Kuiper' over his own innovation.

From this review of the nomenclatural history of the name *P. pseudosphaerium* it is clear that authorship can only be ascribed either to Jutting & Kuiper (1942) or to Schlesch (1947). In defence of the former ascription it is possible to invoke ICZN Article 45(e) (i) which permits a wide interpretation of the term 'variety': 'Before 1961, the use of either of the terms "variety" or "form" is not to be interpreted as an express statement of either subspecific or infrasubspecific rank'. We prefer to follow Ellis (1963), however, and, under the terms of Article 10(b), to ascribe the name to Schlesch (1947) who was the first author validly to raise Jutting & Kuiper's var. *pseudosphaerium* to specific rank.

63. The issue of *Z. Malakozool.* in which *P. supinum* was described is dated August, 1850, but according to Sherborn (1931) it did not appear until February, 1851.

64. HERRINGTON (1954: 135) placed *Pisidium tenuilineatum* Stelfox, 1918, in the synonymy of *P. punctatum* Sterki, 1895, and later (HERRINGTON, 1962: 47) placed both these names in the synonymy of *P. punctiferum* (Guppy, 1867). After discussing this question at length, however, KUIPER (1962c) concluded that *P. tenuilineatum* should be maintained as a distinct species subgenerically distinct from both *P. punctatum* and *P. punctiferum*. More recently, HERRINGTON (1965) has acknowledged his agreement with KUIPER's findings.

65. Our arrangement of this family is based on that of KEEN (1951b) except that, in the subfamily Tapetinae, we have regarded *Polititapes* as a subgenus of *Paphia*, not as a synonym of *Venerupis* (see note **72**), and *Myrsus* as a synonym of *Venerupis*, not as a subgenus of *Tapes* (see note **74**). We have also included the genus *Turtonia* (see note **73**).

66. The section on Pelecypoda by DALL in the EASTMAN translation of ZITTEL's *Text-book of Palaeontology* (1900) was issued separately in advance of the main work in September 1896 (BARTSCH, REHDER & SHIELDS, 1946: 65).

67. WINCKWORTH (1932: 244) included *Venus minima* Montagu in the genus *Gafrarium*, subgenus *Circe*, although earlier he had placed it in the subgenus *Gouldia* (in MARINE BIOLOGICAL ASSOCIATION, 1931: 246). We have followed KEEN (1951b: 3), who accorded generic rank to each of these three taxa. As pointed out by STEWART (1930: 146–147), the early usages of the name *Gouldia* are confusing; some authors (notably DALL) regarded *G. cerina*, the first of the two originally included species, as the type, while others (notably E. A. SMITH) based the name on the second species, *G. parva*, a species of *Crassinella*. STEWART cited a number of papers in which the usage of the name was debated, and concluded that the first species to be validly designated as type was *G. parva*, by SMITH, 1885 (*Rep. scient. Results Voy. Challenger* (Zoology) **13**: 222); he appears to have overlooked a paper by DALL (1883), however, in which the author states: 'I have taken the first, largest, and most conspicuous species of the two as the type.' This seems an unequivocal and valid designation of *cerina* as the type-species, and has already been accepted as such by KEEN (1951b).

68. SCOPOLI included no nominal species in his new genus *Dosinia*. He referred, however, to '*Chama dosin* Adanson'—a pre-Linnaean and therefore unavailable name—and ADANSON's species has generally been regarded as the type. WINCKWORTH (1932: 244) followed earlier authors in identifying *Chama dosin* with *Dosinia africana* Hanley (*recte* Gray) = *Venus afra* Gmelin, a subspecies of *Venus lupinus* L., but FISCHER-PIETTE *et al.* (1942: 308–314) have since shown that ADANSON's species was undoubtedly *Venus concentrica* Born. A strict interpretation of the Code, however, requires the type-species of *Dosinia* to be selected from the first species subsequently associated with it [ICZN Article 69(a) (ii)]. The name *Dosinia* appears to have been overlooked for seventy years until GRAY (1847) cited *Venus exoleta* L. as its type-species. Acceptance of this designation would alter the generic concept and *Pectunculus* would become a junior objective synonym of *Dosinia* s.s. We have hesitated to make this change here, taking the view that other workers may prefer the type of *Dosinia* to be maintained as *Venus concentrica* by the use of the plenary powers. It is also possible that we have overlooked a revival of the name *Dosinia* earlier than 1847, in which case the choice of type-species would be affected.

69. Under the description of '*Cytherea*' *lincta*, BASTEROT (loc. cit.) stated: 'M. DEFRANCE a reçu cette coquille d'Angleterre sous le nom d'*Asa lineata* dont j'ignore l'origine'. *Asa* was, in fact, a LEACH MS. name, and '*lineata*' is presumably a misreading or a lapsus calami for *lincta*. Although first published as a synonym, *Asa* qualifies as an available name with its original author and date as it was so treated prior to 1961 (e.g. KEEN, 1951b: 5) [ICZN Article 11(d), as amended 1964].

70. A number of recent authors (e.g. THIELE, 1934: 893; NICKLÈS, 1950: 205; HABE, 1951: 182; DODGE, 1952: 121) have used the name *Amygdala* Römer, 1857 (*Kritische Unters. Venus*: 16), as a valid senior synonym of *Ruditapes* Chiamenti. There is, however, an earlier use of the name *Amygdala* in Echinodermata* which unfortunately invalidates *Amygdala* Römer.

71. *Irus* has formerly been dated from OKEN, 1815 (*Lehrbuch der Naturgeschichte*). As pointed out by KEEN (1962), however, this work has been placed on the *Official Index of Rejected Works in Zoology* [ICZN Opinion 417] as being non-binominal, and all generic names therein can be validated only by a correct later usage. KEEN assumed that the first subsequent use of the name *Irus* was by OKEN, 1821 (*Naturgeschichte für Schulen*: 647) for two species, neither of which was, in her opinion, a venerid; accordingly, she designated the first of these (= *Solen inaequivalvis* L.) as the type-species of *Irus* Oken, 1821, thereby making the name a synonym of *Pandora*. For *Irus* auctt. KEEN used *Notirus* Finlay, 1928, a group which had previously been accorded separate subgeneric rank. Clearly this was an expedient for nomenclatural convenience, but for any worker regarding the New Zealand *Notirus* as subgenerically distinct from *Donax irus* L. the *irus* group was still without a name. KEEN has already been followed by TEBBLE (1966). Both these authors, however, have overlooked the use of *Irus* by SCHMIDT (1818: 158), who published an extract of OKEN's new classification of the Mollusca. Under *Irus*, SCHMIDT included two species, *inaequivalvis* and *rugosus*, citing *Donax irus* as a synonym of the latter. That species must therefore be the type by tautonymy and *Irus* can continue to be used in its accustomed sense, but with the authorship of SCHMIDT, 1818, *vice* OKEN, 1815.

72. Both HANLEY (1855: 81) and DODGE (1952: 121) equated the *Venus virginea* of LINNAEUS, 1767 (*Systema Naturae*, ed. 12 **1**: 1136), with the European species otherwise known as *V. rhomboides* Pennant, 1777. Although there is a specimen of the latter in the Linnaean collection in London, it is unmarked and cannot be regarded as authentic type-material; nevertheless, many nineteenth-century authors accepted the name *virginea* as being applicable to the European species, despite the locality 'in Indiis' cited by LINNAEUS. HANLEY (loc. cit.), in identifying *V. virginea* L. with the European shell, stated: 'the "pallide incarnata" being an unusual colouring for a *Venus*, has afforded a happy clue to the recognition of this delicately-tinted shell . . . with the exception of a flesh-coloured variety of the *V. rimularis* of LAMARCK, it alone corresponds with the description in the "*Systema*".' PHILIPPI (1844: 35) appears to have been the first to doubt the traditional interpretation of the name *virginea*, and RÖMER (1864: 43; 1870: 59) believed that LINNAEUS's description better fitted the Indo-Pacific *V. rimularis*—a species of *Hemitapes*. In the absence of authentic type-material, the identity of LINNAEUS' species can only be settled unequivocally by the designation of a neotype. With the single exception of DODGE (loc. cit.), however, all recent critical authors have accepted RÖMER's interpretation of the Linnaean *V. virginea* (e.g. HABE, 1951; KURODA & HABE, 1952) and used the name *rhomboides* Pennant for the European species.

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* As this use of *Amygdala* has been dismissed as spurious (e.g. by JUKES-BROWNE, 1914), the facts of the matter are recorded here. LESKE (1778) revised the classification of the echinoderms and gave an account of those systems which had been published since the pre-Linnaean work of KLEIN; among these was that of VAN PHELSUM, 1774. LESKE supplied Latin equivalents for VAN PHELSUM's vernacular names; thus 'Egelmandels' became the genus '*Amygdala*', for which he provided a short Latin description of no diagnostic value. LESKE did not adopt this genus in his own classification but his reference to the name is nevertheless sufficient for it to enter into homonymy under the present Code. A number of generic names similarly dating from this work were suppressed by ICZN Opinion 209, and it is almost certain that this name too would be suppressed if the case were brought to the notice of the Commission. A later use of the name *Amygdala* by GRAY must also be considered. GRAY (1825: 431) states: 'The *Spatangus prunella*, Lam. KŒNIG, *Icones Foss. Sectiles*, t. 3, f. 34, appears to be the type of VAN PHELSUM's genus *Amygdala*, which is peculiar for the anus being nearly dorsal . . .'. According to MORTENSEN (1950: 384), the identity of KŒNIG's figure is 'altogether too uncertain' and the *Amygdala* of LESKE is based on 'a couple of perfectly unidentifiable fossil Spatangoids'. Thus both *Amygdala* Leske and *Amygdala* Gray are unrecognizable and there would seem to be a good case for the suppression of these names in order to validate *Amygdala* Römer. As many authors, however, have become accustomed to using *Ruditapes* for the same taxon, we defer advocating such a change for the time being.

WINCKWORTH (1932: 244) placed *V. rhomboides* Pennant and *V. aurea* Gmelin in the subgenus *Venerupis*, but later (1951) transferred *V. aurea* to *Polititapes*. His failure similarly to transfer *V. rhomboides* was presumably due to an oversight.

The MARINE BIOLOGICAL ASSOCIATION (1957: 330) lists *Venus sarniensis* Turton, 1822 (*Conchylia Ins. Brit.*: 153) as a separate species. HOLME (1961), however, has shown that it is no more than a variety of *V. rhomboides* Pennant.

73. WINCKWORTH (1932: 242) placed this species in the Erycinidae [= Lasaeidae], but its systematic position has always been uncertain. OCKELMANN (1964) has now shown convincingly that it 'should be included in the Veneracea and given a systematic position close to *Venerupis*'. *Turtonia* is included here in the subfamily Tapetinae, but if it should ever be considered desirable to place this genus in a separate subfamily the name Turtoniinae Clark, 1855 (*British mar. test. Moll.*: 5, 96 [Turtoniadae]) is available.

74. WINCKWORTH (1932: 244) listed this species as *Paphia* (*Venerupis*) *pullastra* (Montagu, 1803) (*Testacea Britannica*: 125 [*Venus*]) but, according to most workers on the Mollusca of West and South Africa (e.g. DAUTZENBERG, 1910: 182–183; DAUTZENBERG, 1912: 92; FISCHER-PIETTE *et al.*, 1942: 322–323; NICKLÈS, 1950: 203–204; NICKLÈS, 1955: 189; BARNARD, 1964: 508), MONTAGU'S species is conspecific with the African *Venus corrugata* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3280) and *V. senegalensis* Gmelin, 1791 (tom. cit.: 3282). The present authors concur in this view and have accordingly listed the common British species, otherwise known as *Venerupis pullastra*, as *V. senegalensis*.* GLIBERT & POEL (1966: 86), however, regard *V. pullastra* as a subspecies of *V. geographica* Gmelin, 1791 (*Systema Naturae*, ed. 13 **1**: 3293) [*Venus*].

As *Venus corrugata* Gmelin is the type-species, by selection by STOLICZKA, 1870 (*Mem. geol. Surv. India, Palaeont. Indica* (6) **3**: 145), of *Myrsus* Adams & Adams, 1858 (*Genera Rec. Moll.* **2**: 660), the latter name becomes a junior subjective synonym of *Venerupis*.

75. WINCKWORTH (1932: 244) listed this species as *Venus* (*Chamelea*) *striatula* (da Costa, 1778) (*Historia nat. Test. Britanniae*: 191 [*Pectunculus*]). This seems to be no more than an Atlantic variety with sharper concentric sculpture, of the Mediterranean *V. gallina* L. The sculpture of some specimens from the west of Scotland is similar to that of Mediterranean specimens, but British shells seem always to lack the violet coloration of the pallial sinus which is characteristic of Mediterranean examples. The synonymy of *striatula* with *gallina* has already been accepted by many authors.

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* NICKLÈS (1950: 204) states that the typical *corrugata* is a southern form ranging from Mauritania to the Cape of Good Hope, while 'var. *senegalensis*' has a more extensive range including the Mediterranean and the Atlantic Ocean as far north as Finmark. Thus the British form (*pullastra* Montagu) is equivalent to the 'var. *senegalensis*' not to *corrugata* s.s. Both NICKLÈS and BARNARD (loc. cit.) refer to this species as '*corrugata*', possibly because of the page-priority of that name over *senegalensis*. Under the present Code, however, relative priority is determined not by page-priority but by the action of the first reviser [ICZN Article 24 (a)]. So far as we have been able to discover, FISCHER-PIETTE *et al.* (1942: 323, footnote) acted as first reviser when, under their account of '*Pullastra senegalensis* Gmel.', they stated: '. . . la forme *corrugata* et la forme *pullastra* (= *senegalensis*) sont deux variétés d'une même espèce'. Therefore, as long as the two taxa are regarded as conspecific, the name *senegalensis* should be used to include both varieties.

76. This common West Atlantic species has become naturalized on the Hampshire coast. Its present British distribution is noted by Heppell (1961), Ansell *et al.* (1964) and Tebble (1966).

77. The authorship of the family-group name Petricolidae has occasionally been attributed to Deshayes, 1830 (*Encyclopédie méthod. Hist. nat. Vers* **2**: table facing p. 553), but only the vernacular 'Pétricolées' occurs there. As this attribution has not been generally accepted, the name can take priority only from its first publication in fully latinized form [ICZN Article 11(a) (iii)]. Orbigny (loc. cit.) included *Saxicava* [= *Hiatella*] but did not refer to the genus *Petricola*; it is evident, however, that he must have followed Deshayes in regarding both as included genera (cf. note **27**, p. 118).

78. Ansell (1961) advanced reasons for including *Mysia* in the Veneridae, while Glibert & Poel (1966: 89) placed it in the Cooperellidae. These ideas have not, however, gained general acceptance and *Mysia* is here retained in the Petricolidae for the time being.

79. According to McAlester (1964, 1965, 1966), the Ordovician genus *Babinka* Barande, 1881, represents a transitional evolutionary link between the Silurian to Recent Lucinacea and some monoplacophoran-like ancestor. As there is no strong evidence, he writes, 'to suggest that the Lucinacea have given rise to other major groups of the Bivalvia, with the probable exception of the Leptonacea' [= Galeommatacea], this raises the possibility that the Pelecypoda had a 'polyphyletic' origin from less specialized forms. McAlester concludes that 'the early origin and separate evolutionary development of lucinacean bivalves suggests that the group should be assigned to a separate higher taxon of the Bivalvia. The Lucinacea are probably unrelated to most other "heterodont" bivalves with which they are commonly associated because of a vaguely similar pattern of dentition.' McAlester's views, however, have been strongly criticized by Chavan (1966).

80. *Tellina divaricata* L., 1758, was placed by Winckworth (1932: 242) in *Divaricella* Martens, 1880 (in Möbius, *Beiträge z. Meeresfauna Mauritius u. Seychellen*: 321), possibly in the belief that it was identical with Marten's sole species, *D. angulifera* Martens, 1880 (loc. cit.).* It is, in fact, a totally different species and, as has been shown by Chavan (1951) in his extensive study of '*Divaricella*', exhibits features (notably the presence of lateral lamellae in the hinge) which warrant its generic separation from *Divaricella*.

In Winckworth's list (1932) this species was marked with a 'Q', indicating that its occurrence within the British area was doubtful. Since the publication of that list, however, it has been recorded alive from Scilly by Fowler (1949, 1950, 1952).

81. Thyasiridae is a junior synonym of Cryptodontidae Dall, 1895 (*Trans. Wagner free Inst. Sci. Philad.* **3** (3): 546), but *Cryptodon* Turton, 1822 (*Conchylia Ins. Brit.*: xxxii, 121) is a junior objective synonym of *Thyasira* Lamarck, 1818. Because of this synonymy the family name based on *Cryptodon* has been abandoned and, as the name Thyasiridae has become generally accepted, it is to be maintained in the interests of stability [ICZN Article 40(a)], taking the date of the rejected name, of which it is to be considered the senior synonym [Article 40 (b)].

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* The identity of *D. angulifera* has been a matter of considerable dispute. The older writers, in general, assumed that it was *Tellina divaricata* L.; Dall (1903: 1387) and Lamy (1921: 266, 270) equated it with *Lucina ornata* Reeve, 1850 (*Conchologia Iconica* **6** (*Lucina*): sp. 48) non Agassiz, 1845; Thiele (1934: 867) equated it with *Lucina quadrisulcata* Orbigny, 1845 (*Voyage Amér. mérid.* **5** (Mollusques): 584); while Dodge (1952: 53) believed that it was none of these. Unknown to Dodge, however, the question was settled beyond reasonable doubt by Chavan (1951) who examined specimens from the type-locality [Mauritius] and showed that they corresponded exactly to the original descriptions and figures both of Marten's species and of Reeve's *L. ornata*.

The arrangement of British Thyasiridae given here will be modified considerably by OCKELMANN, 1968 (*Ophelia*, in press), who recognizes four subgenera (including *Axinulus*). *Axinus croulinensis* Jeffreys (1864: 250; 1869: pl 33, fig. 2), a species of *Thyasira* s.s., is shown to be a different species from *Clausina croulinensis* Jeffreys, 1847, which is placed in the subgenus *Axinulus*. The oldest available name for the former species is stated to be *Thyasira obsoleta* (Verrill & Bush, 1898) (*Proc. U.S. natn. Mus.* **20**: 789) [*Cryptodon*]. We are grateful to OCKELMANN for letting us have this advance information.

82. According to the emended Article 11(d) of the ICZN [2nd edition (1964)], a name first published as a synonym is available if, prior to 1961, it has been treated as an available name with its original date and authorship, and adopted as the name of a taxon. *Thyasira* Lamarck, 1818, *ex* LEACH MS. occurs in the synonymy of *Amphidesma flexuosa*.

WINCKWORTH (1932: 242) included in this genus *Poromya subtrigona* Jeffreys. As explained in note **92**, however, we have transferred this species to the Lasaeidae as *Kellia subtrigona*.

83. This species is new to the British List. It was recorded by McINTYRE (1961) from the Fladen ground in the northern part of the North Sea at a depth of about 80 fm. The station from which the specimens were obtained covers only a few square miles centred on the position 58° 20′ N., 0° 30′ E.; as it is part of a flat, muddy ground extending for several hundred square miles, however, and as a preliminary survey of the whole area showed the fauna to be uniform, it is probable that *T. equalis* is widely distributed in this region.

According to OCKELMANN (in McINTYRE, op. cit.), who has examined the type-material of this species, it is identical with his '*Thyasira* spec. a' (OCKELMANN, 1959: 100, 197), while his '*Thyasira equalis*' (op. cit.: 104) is probably a previously undescribed species. (See also note **84**.)

84. *Thyasira gouldii* does not appear to have been recorded as British, but OCKELMANN (personal communication) informs us that he has examined specimens in the U.S. National Museum, labelled 'Shetland', which definitely belong to this species. In the past both *T. gouldii* and *T. equalis* were frequently included in *T. flexuosa* and existing material should be re-examined for possible misidentification.

85. WINCKWORTH (1932: 242, 251) proposed the name *Thyasira ferruginea* for *Kellia ferruginosa* Forbes, 1844 (*Rep. Br. Ass. Advmt Sci.* **for 1843**: 192) non Morris, 1843.* He overlooked the fact that LOCARD had already emended the name to '*Axinus ferrugineus* (Forbes)', and this emendation is a valid replacement for the preoccupied *ferruginosa*.

86. The name *Diplodonta* is customarily dated from volume 2 of BRONN's *Ergebnisse naturhist. Reisen* (p. 484) but, as we have explained previously (note **4**, p. 111), the *Italiens Tertiär-Gebilde* predates the *Ergebnisse*.

STEWART (1930: 193) and GRANT & GALE (1931: 292) have rejected BRONN's name in favour of the earlier *Taras* Risso, 1826 (*Histoire nat. Europe mérid.* **4**: 344) in the belief that its monotype, *T. antiquatus* Risso, 1826 (tom. cit.: 344, fig. 167), a fossil from the Pliocene beds of La Trinité, near Nice, France, is identical with *Diplodonta rotundata* (Montagu). This usage, however, has found little acceptance and we prefer to follow CHAVAN (1952: 121) who, after discussing the problem in detail, concluded that *Taras* Risso and *T. antiquatus* Risso were nomina dubia. In due course application will be made to the ICZN to have these names placed on the *Official Index of Rejected and Invalid Names in Zoology*.

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* On pp. 143 and 168 FORBES refers to what must be this species as '*Lucina ferruginosa*'. Had he retained this name when describing his new species on p. 192 the homonymy with MORRIS' species would have been avoided but, inexplicably, FORBES there placed it in *Kellia*. *Lucina ferruginosa* is a nomen nudum on both pages and thus has no status in nomenclature.

87. The only records for this species appear to be those of MARSHALL (1895: 35) from Eddystone, Land's End and Guernsey, and of CHASTER (1895b) from Plymouth. The present authors have so far been unable to examine specimens and in their assignment of it to *Diplodonta* they are merely following WINCKWORTH (1932: 242).

88. This superfamily has usually been referred to as either the Erycinacea or Leptonacea. As Galeommatidae is the earliest included family-group name, however, it is here used as the basis of the superfamily name.

89. Lasaeidae Gray, 1842, has priority over the more commonly used name Erycinidae Deshayes, 1850* (*Traité élém. Conchyliol.* **1** (2): 718).

90. COSSMANN & PEYROT (1911:166) have pointed out that the hinge of *Lepton nitidum* corresponds exactly to that of *Hemilepton*, which is not a leptonid, but an erycinid [=lasaeid] (CHAVAN, 1960). We follow CHAVAN (*in litt.*), however, in referring *L. nitidum* to *Semierycina*. GLIBERT & POEL (1967: 65) consider *Hemilepton* and *Semierycina* synonymous.

91. According to GRANT & GALE (1931: 301–302), the customary usage of *Kellia* is inadmissible inasmuch as HERRMANNSEN, in 1847 (*Indicis Gen. Malac.* **1**: 568), selected *Cardium rubrum* Montagu as type. They therefore transferred the name *Kellia* to the species here listed as *Lasaea rubra* and for *Kellia* auctt. used *Chironia* Deshayes, 1839 (*Revue zool.* **2**: 357). THIELE (1934: 870) apparently followed GRANT & GALE, but for *Kellia* auctt. used *Tellimya* Brown, 1827. As pointed out by WINCKWORTH (1934b: 52), however, these authors overlooked the earlier designation of type in 1844 by RÉCLUZ who, in his account of *Erycina*, referred to TURTON's genus *Kellia*, mentioning 'le type de son *Kellia*, celui seul qui correspond au caractêre de son genre, le *Kellia suborbicularis*'.

92. The identity and systematic position of this species is not at all clear. Originally it was described by JEFFREYS, from a single left valve dredged off Shetland in shell sand, as *Poromya subtrigona*. This valve, unfortunately, was later smashed (JEFFREYS, 1864: 228). When JEFFREYS subsequently obtained another [right] valve from the same locality he admitted his error in assigning it to *Poromya*, transferred it to *Kellia*, and suggested that it was the '*Kellia cycladia* of SEARLES WOOD' (= *K. cycladea* J. de C. Sowerby, 1844, *Mineral Conchology* **7**: pl. 637, fig. 6).† Later (1881: 704) he again changed its generic placement, this time referring it to *Axinus* [= *Thyasira*]. WINCKWORTH (1932: 242), presumably in the belief that *K. cycladea* was a distinct species no longer living within the British area, revived JEFFREYS's original name for the present species, which he listed as '*Thyasira subtrigona*', but a number of more recent authors have continued to use SOWERBY's earlier name (e.g. MADSEN, 1949: 109—'*Thyasira cycladia* (Jeffreys)'; OCKELMANN, 1959: 197—'*Axinulus cycladius* (S. Wood)'). The specimen identified by JEFFREYS and figured by TEBBLE (1966: 81) as *Thyasira subtrigona* does appear to be a thyasirid, but this specimen was collected in the Bay of Cadiz. On the other hand, one complete shell and four valves reputed to be *T. subtrigona* in the WINCKWORTH Collection‡ have been examined by OCKELMANN, who informs us (*in litt.*) that: 'they represent a species of *Kellia* and certainly not one of *Thyasira*, although they somewhat resemble certain species

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*Date *fide* Cox (1942).

† JEFFREYS (1869: 179) also synonymized *K. orbicularis* 'S. Wood' [*recte* J. de C. Sowerby, 1844, *Mineral Conchology* **7**: pl. 637, fig. 2] with *K. cycladea*. LAMY (1920: 313) treats *K. orbicularis* as a 'var.' of '*Thyasira* (*Axinulus*) *cycladia*'.

‡ Now in the collection of the City of Liverpool Museums.

of that genus'. The authors hope to give fuller treatment to the complex problem outlined above in a separate paper; for the time being they can only tentatively list '*Kellia subtrigona*' as a British species.

93. WINCKWORTH (1932: 243) erroneously gave the date of this species as 1803.

94. HABE (1951: 142) and TEBBLE (1966: 88) place *Devonia* in the family Galeommatidae, but we prefer to follow WINCKWORTH (1932: 243) and CHAVAN (1960) in regarding it as a montacutid.

95. MORRISON (1962) maintained that *Rochefortia** can be distinguished from *Mysella* by the possession of both anterior and posterior lamellae in the right valve, although the two genera have generally been regarded as synonymous. CHAVAN (*in litt.*) believes that MORRISON has confused several genera under the name *Rochefortia*. We have left the three British species in *Mysella*, as listed by WINCKWORTH (1932: 243) until satisfactory evidence for their generic placement elsewhere is forthcoming. TEBBLE (1966: 7) considers both *Mysella tumidula* and *M. dawsoni* to be doubtful British records. The British status of *M. dawsoni* is discussed in note **96.** As TEBBLE presents no reason for discounting the published records of *M. tumidula* (e.g. MARSHALL, 1897: 349—'this species lives in muddy sand throughout the Hebrides, in 18–95 f.') we have retained this species in the present list.

96. Valves of this species have been recorded from a number of localities within the British area, but intact [? living] examples appear to have been taken only by DAWSON who dredged 'two or three perfect specimens' off Cruden in the Moray Firth (JEFFREYS, 1869: 178). The records by MARSHALL (1897: 350) from Scilly, Torbay, Bantry Bay and Bartra Island are, according to MARSHALL (1903: 50), referable to *Epilepton clarkiae*.

It should be noted that JEFFREYS (1876: 490) and most subsequent authors have confused two species under the name *dawsoni*: true *dawsoni* and *Mysella sovaliki* MacGinitie, 1959 (*Proc. U.S. natn. Mus.* **109**: 173). Probably all records of '*M. dawsoni*' from the Arctic (e.g. from Greenland) are referable to *M. sovaliki*.

97. We follow CHAVAN (1960) in separating *Tellimya* from *Montacuta* on the basis of hinge characters. In *Tellimya* the anterior and posterior lamellae are short and tend, more or less, to resemble teeth; in *Montacuta* they are moderately long and show no resemblance to teeth.

98. In the descriptive letterpress to pl. 14 BROWN cites figs. 16 and 17 for *Tellimya elliptica*, but the numbering of the figures on this plate is muddled. In the second edition of the *Illustrations* (1844) the same error is repeated on p. 106, but on p. xii (Systematic Index) the reference is correctly given as fig. 19.

99. This species does not appear to have been recorded as British. WINCKWORTH (1934a: 10) pointed out, however, that as it occurs at Roscoff (DAUTZENBERG & FISCHER, 1925: 126; DEROUX, 1961)—where it is commensal with the sipunculid worm *Phascolion strombi* (Montagu) in old *Turritella* shells—it may well turn up in British waters. Investigation of British specimens of *P. strombi* has so far failed to discover any associated bivalves.

100. According to OCKELMANN (1965), this is *Decipula ovata* Friele, 1875 (*Forh. Vidensk. Selsk. Krist.* **for 1875**: 57) and *Tellimya ovalis* G. O. Sars, 1878 (*Mollusca Regionis Arcticae Norvegiae*: 341).

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* *Rochefortia* Vélain, 1877 (*Archs Zool. exp. gén.* **6**: 113). Type-species, by monotypy: *Rochefortia stralis* Vélain, 1877 (loc. cit.) [St Paul Island, Indian Ocean].

The only records of its occurrence around Britain appear to be those of JEFFREYS (1881: 696) who obtained a single valve off Donegal Bay (183 fm) and of CHASTER (1898: 29) who obtained a further pair of valves from JEFFREYS's dredgings and also dredged 'a few small valves' off the south-west of Ireland (30–48 fm). *Tellimya tenella*, however, has almost certainly been confused with *T. ferruginosa* (Montagu), which it closely resembles, and it seems more than likely that some of the records for this latter species in the North Sea (e.g. those of SCHRADER, 1911) include *T. tenella.*

101. The genera *Neolepton* (including *Lepton sykesi* Chaster, here listed as *Arculus sykesi*) and *Epilepton* were placed by WINCKWORTH (1932: 243) in the galeommatacean family Leptonidae. THIELE (1934: 860) transferred them to his new family Neoleptonidae which he included in the Cyamiacea, and this placement has been followed by most subsequent authors, including WINCKWORTH (1951: 133), although TEBBLE (1966) retains *Neolepton* and *Epilepton* in the Leptonidae and does not recognize any British Cyamiacea. Until recently *Turtonia* was also included in the Cyamiacea* but has now been transferred to the Veneracea (see note **73**), and it is possible that *Neolepton* may have to follow it, as OCKELMANN (*in litt.*) now informs us that *Neolepton sulcatulum* (the type-species of *Neolepton*) is almost certainly a veneracean, although CHAVAN (*in litt.*) writes: 'My illustrations of *N. sulcatulum* for the *Treatise* [*on Invertebrate Paleontology*] are based on two valves in the Geneva Museum, which undoubtedly belong to a cyamiid, not a veneracean.' Until further evidence is forthcoming we prefer provisionally to retain this species in the Cyamiacea. For an account of the difference in hinge structure between Cyamiacea and Erycinacea [= Galeommatacea] see CHAVAN (1960).

102. The systematic positions of *Lepton sykesi* (listed by WINCKWORTH (1932: 243) as *Neolepton sykesi*) and *Neolepton obliquatum* are uncertain. Unfortunately, we have not been able to examine specimens of either of these species and the existing figures are of little help.† CHASTER (1895a: 58) was of the opinion that *L. sykesi* was not a *Neolepton* and MONTEROSATO proposed for it a new genus *Arculus* which CHAVAN (1960: 717) doubtfully included in the Neoleptonidae. *N. obliquatum* has always been regarded as a *Neolepton* but it seems unlikely that it has been examined critically by authors other than MONTEROSATO, CHASTER and possibly WINCKWORTH. It is a rare (or overlooked) species and appears to have been recorded only from off Livorno [Leghorn] in Italy, Palermo in Sicily (MONTEROSATO, 1875: 12; 1878: 68),‡ Rathlin Island, Co. Antrim (CHASTER, 1897: 186) and the south coast of Ireland (CHASTER, 1898: 29). Both British records refer to valves only.

103. DEROUX (1961) established a new genus *Potidoma* for a small bivalve commensal with the polychaete *Polyodontes maxillosus* Ranzani and identified by DEROUX as *Lepton subtrigonum* Folin & Perrier *ex* JEFFREYS MS. After a comparative study of the shell and anatomy of several small species commonly referred to the Erycinacea [= Galeommatacea], he concluded that *Potidoma subtrigonum* and *Epilepton clarkiae* are congeneric and, accordingly, transferred *E. clarkiae* to his new genus. He then transferred both to the family Montacutidae. DEROUX argued that, as the genus *Epilepton* has been placed in the Neoleptonidae and that family moved from the Erycinacea to the Cyamiacea, the fact that *E. clarkiae* is, in his opinion, a montacutid warrants its inclusion in a new genus. As pointed out by HEPPELL (1964: 311), this argument is fallacious, since *E. clarkiae* is the type-species of *Epilepton*. If *E. clarkiae* is a montacutid the genus *Epilepton* will have to be transferred back to the

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* It was customary to place *Turtonia* in the separate family Turtoniidae Clark, 1855. As this predates Cyamiidae Sars, 1878, the name of the superfamily should have been Turtoniacea. Acceptance of *Turtonia* as a venerid fortunately renders this change unnecessary.

† *L. sykesi* has been figured only by MARSHALL (1895: 37, fig. 2) and TEBBLE (1966: 87); *N. obliquatum* only by CHASTER (1897: 186, figs. 1, 2).

‡ The publication of the name *Neolepton obliquatum* in these two papers predates its description by CHASTER, but MONTEROSATO listed it only as a nomen nudum.

Galeommatacea (where it will be available for the reception of *L. subtrigonum* too), but until further evidence is forthcoming on this point we refrain from making any such change and follow Chavan (1960) in regarding *Epilepton clarkiae* as a species in the Cyamiacea.

104. Newell (1965: 19) included the Astartidae in the superfamily Crassatellacea, as he considered Crassatellidae Menke, 1830 [*recte* Menke, 1828 (*Synopsis method. Moll.*: 65 [Crassatellaceae])], to be the earliest valid family-group name among its components [ICZN Article 23(d) (i)]. There are, however, objections to the use of this name. Many recent authors have held the view that the type-species of *Crassatella* Lamarck, 1799, must be the species cited by Lamarck as '*Mactra cygnea* Chemnitz', even though the characters of that shell do not correspond with Lamarck's generic description. Chemitz's species is a mactrid and, as the interpretation of the family-group name Crassatellidae must depend on the interpretation of the generic name *Crassatella*, Crassatellidae would, therefore, become a junior synonym of Mactridae Lamarck, 1818. Other names for the family in question, such as Crassatellitidae and Eucrassatellidae, are later than Astartidae, and Crassatellitidae, moreover, is based on *Crassatellites* Krueger, 1823, which is invalid under Article 20 (see also Iredale, 1921: 207–208). For a full discussion of the status of *Crassatella* Lamarck see Stewart (1930: 134–136). Because of the uncertainty concerning the correct interpretation of *Crassatella* Lamarck, 1799, we prefer to retain the name Astartacea for the present superfamily.

Although Astartidae dates from Orbigny, 1844, it takes priority as of the date of its senior synonym Crassinidae Gray, 1840 (*Synopsis Contents Br. Mus.*, ed. 42: 137, 150) [Article 40(b)].

105. Grant & Gale (1931: 266) give the type-species of *Astarte* as *A. lurida* Sowerby, by selection by Stoliczka, 1871 (*Mem. geol. Surv. India, Palaeont. Indica* (6) **3**: xx). There can be no doubt, however, that Sowerby's statement: '. . . are *Venus Scotica* (which may be taken as the type of the genus) . . .' constitutes a valid type-designation. Page 81 of this volume of the *Mineral Conchology* is wrongly numbered '85'.

106. The classification of the Astartidae has been discussed by Chavan (1952). *Tridonta* is typically boreal and has a more complete hinge than *Astarte*. *Astarte* is not typically boreal but extends into warm temperate seas.

107. Tebble (1966: 72) includes this species although there are no records of it from the British area. Davis (1925), however, recorded a single specimen from 19 fm at 55° 25′ N., 2° 59′ E. As the species occurs in the eastern part of the North Sea as far south as Denmark, it is possible that its range may also extend to the north-eastern parts of the British coast. The known distribution and vertical range of *T. borealis* is given by Ockelmann (1959: 79).

108. Our arrangement of this family is based on that of Keen (1951a). Our attribution of certain family-group names to Lamarck, 1818, has already been explained (see note **12**, p. 113).

109. Winckworth (1932: 243) gives the type-species of *Acanthocardia* as *Cardium echinatum* L., 1758, but we have been unable to find any designation of that species as type which pre-dates Stoliczka's designation. It should be noted that the termination '*-cardia*' is feminine singular, not the plural of the neuter '*-cardium*'.

110. This species was listed by Winckworth (1932: 243) as a Sarnian species, but it has since been recorded from Falmouth and Scilly (Gardiner, 1947). Winckworth included it in the subgenus *Parvicardium* Monterosato: we follow Keen (1951a: 8), however, in placing it in *Papillicardium*, a subgenus of *Plagiocardium*. Dr Keen originally included *Plagiocardium* in the subfamily Laevicardiinae, but she now informs us (personal communication) that it should be placed in the Cardiinae.

111. This type-designation appears to have been overlooked by WINCKWORTH (1932: 244) as he gives the type as *Cardium europeum* Swainson [presumably by selection by BUCQUOY, DAUTZENBERG & DOLLFUS, 1892 (*Mollusques mar. Rousillon* **2**: 298)].

112. In the collection of the Royal Scottish Museum are two specimens of *Cerastoderma elegantulum* (Möller, 1842)* labelled 'Shetland' which appear to have been collected alive. There are, however, no published records of this species from the British area and, as it is possible that the indication 'Shetland' refers to deeper water north of the 100 fm line, we refrain from introducing this species to the British list on the strength of these two specimens alone.

113. The many named varieties generally grouped under *Cerastoderma edule* (L.) were shown by MARS (1951) to be referable to two distinct species, true *edule* and *C. glaucum*. Both species occur in Britain, the 'subspecies' *lamarcki*† and *beltica*† listed by WINCKWORTH (1932) being part of the *C. glaucum* complex. The authorship of *C. glaucum* is in doubt as the name was proposed by both POIRET and BRUGUIÈRE in the same year.‡ MARS (op. cit.) attributes the name to BRUGUIÈRE because the species is best known from his work, whereas we have followed SHERBORN's *Index Animalium* in our ascription of it to POIRET. PETERSEN (1958) and TEBBLE (1966) figure *C. glaucum* (under the name *C. lamarcki*) and note the specific differences between it and *C. edule*; the specimen figured by TEBBLE on p. 105 (Fig. 55b), however, appears to be merely a thin-shelled specimen of *C. edule*. To the recorded British distribution of *C. glaucum* may be added North Uist and South Uist, Outer Hebrides;§ these are the first records of the species from Scotland.

114. This species, traditionally included in the genus *Venus*, is considered by KEEN (1954: 52) and GLIBERT & POEL (1966: 41) to be a *Circomphalus*.

115. *Clausinella fasciata* has generally been placed in the subfamily Chioninae (e.g. by KEEN, 1951b) as anterior lateral teeth are absent in that species. We have followed GLIBERT & POEL (1966: 37) in transferring *Clausinella* to the Venerinae as those teeth *are* present in other species unanimously considered to be congeneric.

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* MÖLLER, 1842 *ex* BECK MS. (*Index Moll. Groenlandiae*: 20 [= *Naturh. Tidsskr.* **4**: 93]) [*Cardium*].

† *Cardium lamarckii* Reeve, 1845 (*Conchologia Iconica* **2** (*Cardium*): pl. 18, sp. 93); *Cardium belticum* Reeve, 1845 *ex* BECK MS. (tom. cit.: pl. 20, sp. 113).

‡ POIRET, 1789 (*Voyage en Barbarie* **2**: 13); BRUGUIÈRE, 1789 (*Encyclopédie méthodique. Histoire nat. Vers* **1**: 221). POIRET (tom. cit.: 10, footnote) stated: 'M. BRUYÈRE [sic = BRUGUIÈRE] a bien voulu me communiquer, sur quelques-unes de ces coquilles, le travail qu'il a fait pour l'Encyclopédie, & ses observations sur les espèces nouvelles que j'ai rapportées'. On the other hand, BRUGUIÈRE (loc. cit.) refers to POIRET's discovery of the species on the Algerian coast.

§ Specimens in the Royal Scottish Museum, Edinburgh, collected by A. R. WATERSTON from Loch an Duin, Trumisgarry, North Uist, July 1933 and from Loch Bee, South Uist, July 1967.

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J. Conch. **26**: 273–274. (1968)

OBITUARY

Robert Rendall, 1898–1967

Robert Rendall was born in Glasgow on 24 January 1898, the elder son of Robert Peterson Rendall, Master Mariner, and his wife Barbara Craigie Garrioch, both of Orkney. The family returned to Orkney in 1905 and Robert went to Kirkwall Burgh School (Kirkwall Grammar School) until he was thirteen, when he left to be apprenticed to a firm of drapers (in which he eventually became a partner) in Kirkwall. All his working life was spent with the same firm, but in his leisure time he read and studied in a wide variety of fields.

One of his major interests was natural history in its widest sense, and as a boy he made collections of beetles and butterflies, seaweeds and shells. Marine life in particular fascinated him and he never lost his deep interest in it, later concentrating upon the Mollusca. In quest of them he combed the Orkney shores and many years of patient work culminated in his *Mollusca Orcadensia*, published by the Royal Society of Edinburgh in 1956. This included early Orcadian records from various sources and also those gathered by Winckworth when he was stationed in Orkney during World War I. The non-marine species Rendall did not much care for, but he dredged and shore-collected marine species with the utmost assiduity and altogether about three hundred species are listed with details of habitat and abundance. His work was careful and thorough and his *Mollusca Orcadensia* will long be a standard list for these northern isles.

In 1929 Rendall became a Member of the Conchological Society and published several papers on Orkney Mollusca in this *Journal*. In later years several long holidays on the Adriatic coast of Italy enabled him to collect Adriatic Mollusca and in 1964 he published a list of species taken at Pesaro. He also published a charming book, part autobiography, part natural history (including much on Mollusca), called *Orkney Shore*. He gave unstinting aid to visiting biologists and I believe helped much with Dr R. J. Lewis's survey of the intertidal zones of our coasts (afterwards published as *The Ecology of Rocky Shores*). Latterly he had become interested in hydroids and had made plans for their collection and study, but ill-health prevented this coming to fruition.

He did a certain amount of work on local archaeology during the heyday of the Orkney Antiquarian Society, and worked with Dr Hugh Marwick on the collection of Orkney place-names, as the latter fully acknowledged in his *Orkney Farm Names*. Rendall also wrote an interesting account of the Orkney names for shells and their use in children's games.

He was a deeply religious man and published two books on religious matters as well as many articles. He was a poet, rather after the style of Edwin Muir whose work he greatly admired, and had to his credit three slender books of poems (*Country Sonnets*, *Orkney Variants*, and *Shore Poems*). Just before his death he issued a small pamphlet of further poems called *The Hidden Land*.

During the last few months of his life he and his friends were very pleased to learn that he had been awarded a Civil List Pension for his services to literature and science. He died on 8 June 1967.

As a naturalist Robert Rendall belonged to that distinguished company of self-taught Scottish naturalists which included Hugh Miller, Robert Dick and Thomas Edward, and Orkney is justly proud of him. But his interests were very wide, and he might well have written, as Augustine Henry the great Irish arboriculturist once did: 'One wants a thousand years to take in all the things that one ought to be interested in'. In his seventy years of life Robert Rendall managed to take in a great many things and to enjoy them all. His fine collection of shells is to find a fitting home in Stromness Museum.

A personal note—I like to remember Robert Rendall telling me with gentle pride that he had a blackbird in his garden so tame that it would take food from his hand.

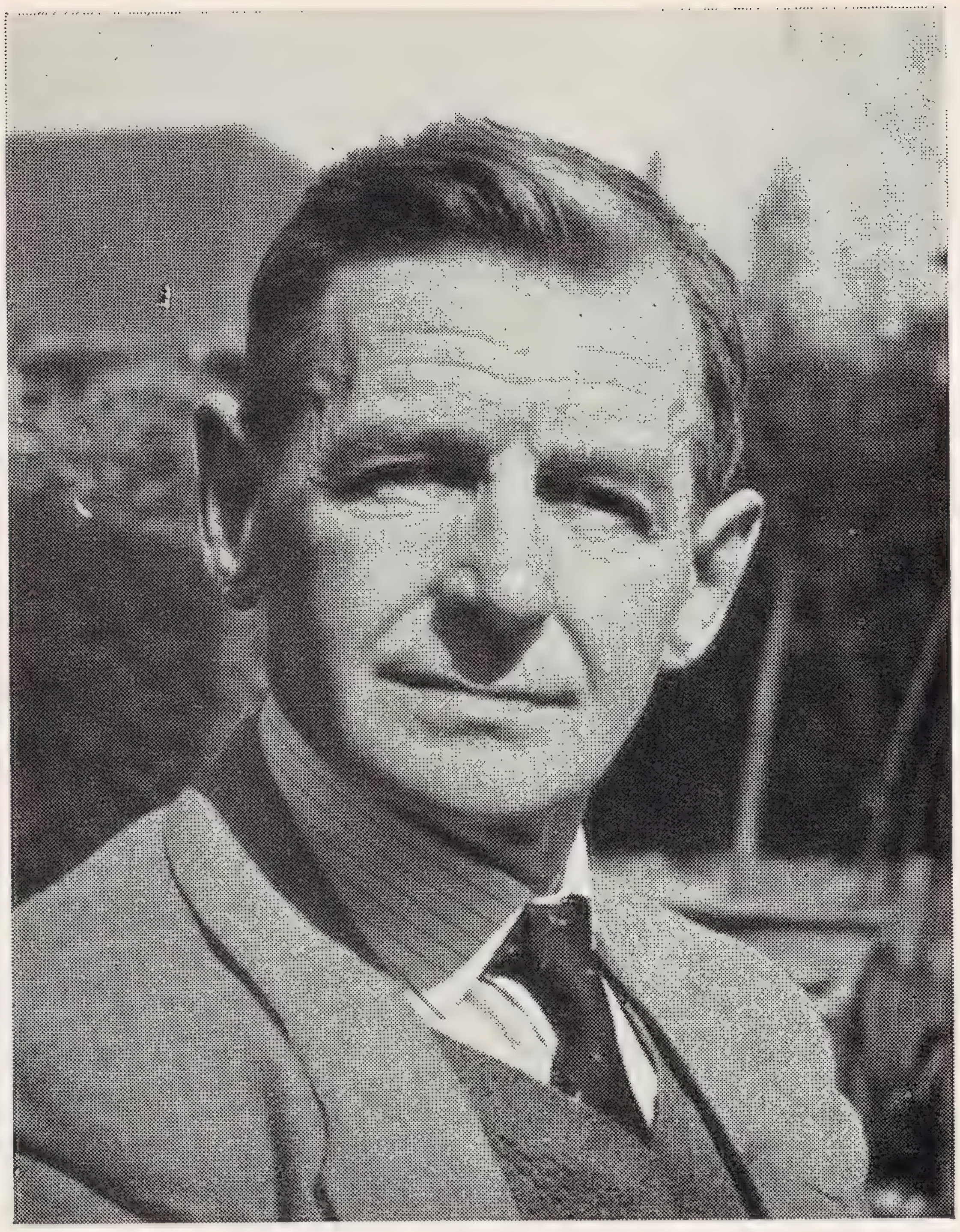
Conchological Publications by Robert Rendall

1931 Notes on *Eledone cirrosa* Lamarck. *J. Conch.* **19**: 161–162.
1931 *Helix aspersa* in Orkney. *J. Conch.* **19**: 163.
1936 *Simnia patula* (Pennant) in Orkney. *J. Conch.* **20**: 283–285.
1948 *Mya arenaria* L. in Orkney. *J. Conch.* **23**: 8.
1948 Wallace's list of Orkney Mollusca. *J. Conch.* **23**: 17–19.
1953 Traill's list of Orkney Mollusca, with special reference to *Pinna fragilis*. *J. Conch.* **23**: 327–330.
1954 A survey of some Orkney beaches. *J. Conch.* **23**: 390–394.
1954 Orkney shell names and shell games. *Orkney Miscellany* **2.** 12 pp. [*Orkney Record and Antiquarian Society Papers.*]
1955 Coalfish feeding on *Patina pellucida*. *J. Conch.* **24**: 39.
1955 *Mya arenaria* in Orkney. *J. Conch.* **24**: 39.
1956 Mollusca Orcadensia. *Proc. R. Soc. Edinb.* (B) **66**: 131–201.
1957 *Pinna fragilis* in Orkney. *J. Conch.* **24**: 174.
1957 *Eubranchus tricolor tricolor* Forbes in Orkney. *J. Conch.* **24**: 178–179.
1960 *Orkney Shore*. Kirkwall: The Kirkwall Press. 200 pp.
1961 *Zirfaea crispata* (L.) in Orkney. *J. Conch.* **25**: 39.
1964 A collection of shells from Pesaro, Italy. *J. Conch.* **25**: 241–242.

Nora F. McMillan

K. Rendall

PLATE 12



H. E. Quick

J. Conch. **26**: 275–277. (1968)

OBITUARY

HAMILTON ERNEST QUICK, 1882–1967

HAMILTON ERNEST QUICK died at his home in Reading on 23 May 1967. He was born in Sydney, N.S.W., on 13 November 1882, the son of CHARLES and FLORENCE QUICK of Penzance, Cornwall. His father was assayer and works manager of the Anglo-French Nickel Company. Educated at Swansea Grammar School and the Royal College of Science, South Kensington, he took his B.Sc. degree in 1902 and then entered St Bartholomew's Hospital Medical School. He graduated M.B., B.S. (Lond.) in 1906, and three years later became F.R.C.S. (Eng.). After house appointments in London, Southampton and Swansea, he was appointed Honorary Ophthalmic Surgeon at Swansea General and Eye Hospital, a post he occupied for 39 years. On his retirement he was made Honorary Consulting Surgeon. He was also ophthalmic surgeon to the Swansea, Pembrokeshire and Breconshire Education authorities and was a medical referee to the Home Office. During the First World War QUICK saw active service with the 3rd Welsh Field Ambulance. He took part in the landing at Suvla Bay, Gallipoli, in 1915 and was mentioned in dispatches. QUICK was married in 1918 to ADELAIDE RUTH HELLINS, daughter of Mr and Mrs H. H. HELLINS; Mrs HELLINS was related to Sir HUMPHREY DAVY. His wife died in 1946 and he is survived by two married daughters.

QUICK was elected a Member of the Conchological Society in 1916, of which he was President 1941–42 and was elected an Honorary Member in 1955. He was also a Member of the Malacological Society of London, of which he was President 1950–53 and Editor 1951–56. He was a good all-round naturalist with a special knowledge of several groups, such as woodlice, grasshoppers and false-scorpions, but Mollusca were his chief love. While his knowledge of British non-marine gastropods was exhaustive, he made certain groups which require dissection for their determination—namely Succineidae, Vitrinidae and slugs—peculiarly his own: as an authority on the first of these he established a world-wide reputation, and the genus *Quickella* C. R. Boettger, 1939 (type-species: *Succinea arenaria* Bouchard-Chantereaux) was named in recognition of his researches. His paper on 'The anatomy of British Succineæ' (1933) was so authoritative that the Recorder of non-marine Mollusca had to scrap earlier records of the British species and make a fresh start. His last major publication, 'British Slugs' (1960) may be regarded as his magnum opus and is indispensable to all students of this group. No one can ever write about British slugs without referring to the work of QUICK.

Before failing health prevented him from making the journey to London, QUICK was most regular in his attendance at the meetings of the Conchological Society, where his opinions, offered in his quiet, almost shy, manner, always received the respect due to them. On the occasion of the visit of delegates to the First European Malacological Congress to Juniper Hall Field Centre, Mickleham, on 20 September 1962, he received a royal welcome on his arrival, attired in a track-suit, at tea-time. The writer had the privilege of working with him on Mollusca courses at the Field Studies Council's centres at Malham, Yorkshire and Juniper Hall, Surrey. I shared a room with him and got to know him well. The longer one knew 'Doc', as he was affectionately known at the centres, the more one's respect and affection grew. He always spoke quietly, yet there was authority in what he had to say. He was kind and gentle and possessed a quiet humour which was infectious. When we were at Malham he was over 70, yet the longest trek over rough country never daunted him. He was philosophical by nature and, during a very dry spell, did his best to produce slugs for the students with the aid of a watering can.

Undoubtedly his skill as an ophthalmic surgeon contributed to his mastery of dissection. To watch him dissect a minute snail was an education. His many anatomical papers were illustrated with his own neat drawings, and his illustrations of slugs in his *Synopsis* (1949) and *Bulletin* (1960) display artistic competence. This skill was employed on his Christmas cards, usually molluscan and humorous, though I have before me a delightful coloured picture of *Testacella maugei* received at Christmas 1962.

QUICK was always generous with his time and knowledge. Juniper Hall and the Department of Zoology at Reading University, to which he gave of both unstintingly, will miss him greatly. To conchology and to the Conchological Society his loss is grievous. To those of us who knew him the happy memory of this kindly, lovable man will ever remain. An obituary and portrait appeared in the *British Medical Journal*, 17 June 1967 (No. 5554), p. 772.

LIST OF PUBLICATIONS BY H. E. QUICK

1918 *Helix pisana* Müll. at Swansea. *J. Conch.* **15**: 288.
1920 Notes on the anatomy and reproduction of *Paludestrina stagnalis*. *J. Conch.* **16**: 96–97.
1920 Parthenogenesis in *Paludestrina jenkinsi* from brackish water. *J. Conch.* **16**: 97.
1924 Length of life of *Paludestrina ulvae*. *J. Conch.* **17**: 169.
1925 *Vertigo angustior* in Glamorgan. *J. Conch.* **17**: 223.
1926 Shell pockets of Oxwich dunes. *J. Conch.* **18**: 57–60.
1927 Oecological notes on the Oxwich sand dune area. *J. Conch.* **18**: 119–122.
1927 A note on *Helix pisana* at Swansea. *Proc. Swansea scient. Fld Nat. Soc.* **1**: 11.
1931 *Physa acuta* at Singleton. *Proc. Swansea scient. Fld Nat. Soc.* **1**: 129.
1933 *Isidorella pyramidata* (Sow.). *J. Conch.* **19**: 322–328.
1933 The anatomy of British Succineæ. *Proc. malac. Soc. Lond.* **20**: 295–318.
1934 The development of the radula and jaw and of the specific differences in young *Succinea pfeifferi* Rossm. and *Succinea putris* (L.). *Proc. malac. Soc. Lond.* **21**: 96–103.

1934 *Isidorella pyramidata* (Sow.): a correction. *J. Conch.* **20**: 50.

1934 Conchological notes. *Proc. Swansea scient. Fld Nat. Soc.* **1**: 217.

1935 On the occurrence of *Caecilioides acicula* Müller, in the Gower Peninsula. *Proc. Swansea scient. Fld Nat. Soc.* **1**: 286–289.

1936 The anatomy of some South African Succineæ, and of *Succinea hungarica* Hazay and *S. australis* Férussac for comparison. *Ann. Natal Mus.* **8**: 19–45

1936 Notes and records. Mollusca. *Proc. Swansea scient. Fld Nat. Soc.* **1**: 322.

1937 Slimming drugs and cataract, with notes of a case. *Br. med. J.* **1937** (1): 1203–1204.

1937 [With A. R. WATERSTON] *Geonemertes dendyi* Dakin, a land nemertean, in Wales. *Proc. R. Soc. Edinb.* **57**: 379–384.

1938 The medicinal leech *Hirudo medicinalis* Linn. in Breconshire, with notes on the other species of Hirudinea found in South Wales. *Proc. Swansea scient. Fld Nat. Soc.* **2**: 12–14.

1939 *Hyalimax mauritianus* Fischer, a succineid slug from Mauritius. *Bull. Maurit. Inst.* **1**: 57–61.

1939 Some particulars of four Indo-Pacific *Succinea*. *Proc. malac. Soc. Lond.* **23**: 298–302.

1939 On *Succinea andecola* Crawford. *Proc. malac. Soc. Lond.* **23**: 333–335.

1943 Land snails and slugs of West Glamorgan. *J. Conch.* **22**: 4–12.

1946 The mating process in *Arion hortensis*, Férussac, and in *Arion subfuscus*, Draparnaud. *J. Conch.* **22**: 178–182.

1946 Obituary, Ernest Le Cronier Lancaster, 1862–1945. *Proc. malac. Soc. Lond.* **27**: 5.

1947 *Arion ater* (L.) and *A. rufus* (L.) in Britain and their specific differences. *J. Conch.* **22**: 249–261.

1949 Slugs (Mollusca). (Testacellidae, Arionidae, Limacidae.) *Synopses Br. Fauna* No. 8. Linnean Society of London.

1949 *Limapontia depressa* Alder and Hancock in Suffolk and Glamorgan. *J. Conch.* **23**: 84.

1950 The spermatophore of *Milax sowerbii* (Férussac). *J. Conch.* **23**: 111–112.

1950 Observations on *Limapontia*. *Proc. malac. Soc. Lond.* **28**: 134–138.

1951 *Agriolimax laevis* (Müller) feeding on mealy bugs. *J. Conch.* **23**: 146.

1951 *Succinea archeyi* Powell. *Rec. Auckland Inst. Mus.* **4**: 123–126.

1952 Rediscovery of *Arion lusitanicus* Mabille in Britain. *Proc. malac. Soc. Lond.* **29**: 93–101.

1952 A key to the identification of the shells of the land snails of Reading area. *Reading Nat.* (4): 1–10.

1952 Emigrant British snails. *Proc. malac. Soc. Lond.* **29**: 181–189.

1953 [Obituary] Wilfrid Mark Webb. *Proc. malac. Soc. Lond.* **29**: 215.

1953 Helicellids introduced into Australia. *Proc. malac. Soc. Lond.* **30**: 74–79.

1954 *Cochlicopa* in the British Isles. *Proc. malac. Soc. Lond.* **30**: 204–213.

1954 Journey to the Gughé Highlands (Southern Ethiopia), 1948–49: Gastropoda, slugs from the high mountains. *J. Linn. Soc.* (Zoology) **42**: 382–386.

1954 *Helix pomatia* L. with abnormal genital ducts. *J. Conch.* **24**: 12.

1954 [Review] *An Introduction to Molluscan Ecology*, by Alan Mozley. *J. Conch.* **24**: 25.

1954 [Report of Field Meeting] Pangbourne, Berkshire, 13 June 1954. *J. Conch.* **24**: 25.

1956 [Review] *Sites of Infection*, by Alan Mozley. *J. Conch.* **24**: 104.

1957 [Review] *Liver-fluke Snails in Britain*, by Alan Mozley. *J. Conch.* **24**: 212.

1957 *Succinea flexilis* sp. nov. from Gough Island. *Proc. malac. Soc. Lond.* **32**: 203–206.

1958 *Vitrina major* (Férussac) in Surrey, with some remarks on the species. *J. Conch.* **24**: 235–238.

1958 *Vitrina major* (Férussac) in Surrey: a correction. *J. Conch.* **24**: 286.

1959 [Appendix to 'Some land Mollusca from northern Iraq', by H. E. J. Biggs] *Levantina kurdistana* (Parreyss), L. Pfeiffer. *J. Conch.* **24**: 347–348.

1959 Obituary. Hugh Watson, 1885–1959. *J. Conch.* **24**: 359–360.

1960 British Slugs (Pulmonata; Testacellidae, Arionidae, Limacidae). *Bull. Br. Mus. nat. Hist.* (Zoology) **6**: 103–226.

1960 *Hygromia liberta* (Westerlund) and *H. hispida* (L.) living together. *J. Conch.* **24**: 397.

1960 *Limax* (*Lehmannia*) *poirieri* Mabille near Reading. *J. Conch.* **24**: 398.

1960 *Hygromia subrufescens* (Miller) and *H. subvirescens* (Bellamy) living together. *J. Conch.* **24**: 418.

L. W. STRATTON

REVIEWS

Shell-bearing Mollusks (Loricata) of the seas of the U.S.S.R. by A. M. YAKOVLEVA. Translated from the Russian by A. MERCADO. Jerusalem: Israel Program for Scientific Translations, 1966. Distributed in the U.K. by Oldbourne Press, London. pp. viii + 127, including 11 plates and 53 text-figures. *IPST Cat. No.* 1257. 9¾″ × 6¾″. Price 31/6d or U.S. $4.50. [First published as *Pantsyrnye mollyuski morei SSSR*. Moskva: Akademiya Nauk SSSR, 1952. *Opred. Faune SSSR* **45**.]

This is an account of the chitons of the Barents, White, Kara, Laptev, East Siberian and Chuckchee Seas in the Arctic, the Sea of Okhotsk and Sea of Japan in the Far East, and the Black Sea; chitons are absent from the other seas of the U.S.S.R., viz the Caspian and Aral Seas, the Sea of Azov and the Russian Baltic. The volume includes a 35-page Introduction, followed by six pages of Bibliography; about half the works cited are in Russian and therefore comparatively unknown in this country. The remainder of the book is devoted to the taxonomic section, forty-one species being represented including eight of the twelve species found in British waters. Two genera and eleven species are described as new. Reference to the original is facilitated by the inclusion of the page-numbers of the Russian edition in the left-hand margins. The line-drawings are excellently reproduced, but reproduction of the half-tone illustrations is poor, with considerable loss of detail.

The Introduction contains a useful general account of the Loricata, with details of anatomy and shell morphology, development, ecology and phylogeny. All terms peculiar to the class are defined. The section on the radula is particularly detailed, as the author stresses the importance of that organ in chiton taxonomy. This is followed by an analysis of geographical distribution, in which the chiton fauna of each of the seas of the U.S.S.R. is tabulated and related to zoogeographical regions. Preparation of specimens for identification and a technique for mounting chiton radulae are described at the end of this chapter.

In the taxonomic section each species is treated on a common plan: synonymy—description—distribution—ecology. The radula of every species is figured and their shells are illustrated on the plates. Descriptions are also given of the families and genera, and dichotomous keys to the included genera and species are provided.

A number of errors occur in the Russian original which, of course, remain uncorrected in the translation. *Lepidopleurus asellus* is attributed to the non-binominal author CHEMNITZ, instead of to GMELIN, although the type-species of *Lepidopleurus* is given as '*Lepidopleurus asellus* Lowe, 1825'. This too is incorrect as the type-species is *L. cajetanus* Poli. Similarly, the type of *Ischnochiton* is incorrectly given as *I. mertensii*, which was not an originally included species. *Lophyrochiton* is proposed as a new genus for *albus* L., but WINCKWORTH validated MIDDENDORFF's use of *Stenosemus* for that species, so *Lophyrochiton* must be considered a synonym. *Lepidochiton marginatus* (Pennant) (= *L. cinerus* (L.)) is said to be sublittoral, although it is a common littoral species in Britain.

A few other errors and inconsistencies have been introduced in the translation. The first three lines on p. 68 are misplaced: they belong to *Lepidochiton aleuticus* on p. 67. The apparent contradiction in the distribution of *Acanthochiton fascicularis* (L.) (= *A. crinitus* (Pennant)) on pp. 87–88 is due to a lack of subtlety in the translation. As the majority of Mollusca are shell-bearing, the rendering of 'pantsyrnye mollyuski' as 'shell-bearing mollusks' instead of 'chitons' in the title and on p. 22 is inept; the vernacular 'coat-of-mail shells' exactly conveys the sense of 'pantsyrnye'. Curiously, the author's name is transliterated as YAKOVLEVA on the title-page, but is left as 'JAKOVLEVA' wherever a new species is described. The following are among the minor errors noted: 'ventricle' for 'stomach' [p. 1], 'Table 1' for 'Plate IV' [p. 3], 'leg' for 'foot' [p. 8, fig. 1], 'most *Asellus* species' for 'many *Lepidopleurus* species' [p. 19], 'North Atlantic' for 'North Pacific' [p. 19, end of paragraph on *Tonicella rubra*].

An excellent justification for this work may be found in the author's foreword: 'Little is known of the marine mollusks of the U.S.S.R. . . . The class Loricata . . . is the least known of all the molluscan groups'. YAKOVLEVA undoubtedly did much to rectify this, and the present translation will make possible a fuller appreciation of her work.

DAVID HEPPELL

Shell Collecting: An illustrated history by S. PETER DANCE. London: Faber and Faber Ltd, 1966. pp. 344, 35 pls. (3 in colour). Demy 8vo. Price 63s.

This attractive book will be welcomed by conchologists all over the world, being the first attempt to provide an authoritative history of shell collecting. As C. M. YONGE has said in a foreword: 'Shells make compelling appeal to an unusual variety of people'. They interest the collector to whom their infinite variety is a delight to the eye and also the biologist to whom all aspects of molluscan life, including shell formation, functional morphology and physiology, present many intriguing problems.

Here Mr DANCE ably traces the growth of this fascinating cult; its origins certainly go back to prehistoric times, for shells appear in all the early cultures as amulets, trumpets and coinage. Dyes too were long extracted from the tissues of the Muricidae. However, the written record really begins with ARISTOTLE, whose *Historia Animalium* was to remain the chief source of information for nearly 2,000 years. The Dark Ages produced very little apart from the occasional use of shells to illustrate manuscripts of monastic origin, of which one example, a page from a fourteenth-century Italian manuscript attributed to CYBO D'HYÈRES, is reproduced in colour; this depicts some typical Mediterranean species and one exotic cowry, *Cypraea moneta* L.

The Renaissance and the early voyages of discovery awakened the interest of savants in the world around them and shells were among the curiosities that were collected along with ethnographical material and dried natural-history objects. Mr DANCE has delved deeply to unearth details of some of these early collectors in various European countries, notably CONRAD GESNER in Switzerland, BESLER in Germany, PALISSY in France, OLE WORM in Denmark and JOHN TRADESCANT in England. We are told that the foundations of modern collecting began to be laid in the second half of the seventeenth century by the Italian BUONANNI, MARTIN LISTER in England, and the Dutchman RUMPHIUS, whose books provided much information and, on the whole, accurate illustrations for the collector. In this pre-Linnaean era collecting became fashionable even in Court circles in Europe, the royal cabinets especially attracting collector-writers, such as REGENFUSS and D'ARGENVILLE, who published illustrated accounts of them. A wealth of fascinating information is provided on the contents of these cabinets and on how many of the rarities were acquired. Frequently, for the rarest and most prized shells, the author is able to trace their history from owner to owner, the prices paid for them at auction and their present whereabouts. The holotype of *Conus gloriamaris* was recognized in the collections of the University Museum in Copenhagen by the late Dr ANTON FR. BRUUN in 1945, while a large number of MARTIN LISTER's specimens were rediscovered in the British Museum (Natural History) by the late Mr G. L. WILKINS. Many of these and other historically interesting items have been photographed anew for this book, notable examples being *Strombus listeri* T. Gray (once the property of JOHN TRADESCANT the younger), *Epitonium scalare* (L.) (owned by Queen LOUISA ULRICA, 1720–1782, of Sweden) and *Astraea heliotropium* (Martyn) (collected on Captain JAMES COOK's second circumnavigation).

The publication of the *Systema Naturae* of Linnaeus did not have an immediate effect on conchological progress because it was not illustrated, but its revolutionary approach was appreciated by writers of new illustrated shell books; the development and content of the latter are discussed in some detail. Interest at this time was further stimulated by the contemporary voyages of discovery.

There are chapters too on the Lamarckian era and on early shell collecting guides, especially of the early nineteenth century, with much historical and diverting information on collectors, auctions and prices. Two chapters on that prince of collectors, HUGH CUMING, and his contemporaries are of particular interest. There is a new and much needed appreciation of CUMING, tracing his career and clearing up many misunderstandings about his life. This is followed by an account of the more prominent collectors and cabinets of the nineteenth century.

The second half of the text is devoted to four shells: the Precious Wentletrap (*Epitonium scalare*), the Glassy Nautilus (shell of the heteropod *Carinaria cristata*), *Conus 'cedonulli'* and *Conus gloriamaris*. Of these, the last is dealt with in considerable detail, twenty-one pages (probably too many considering that collectors are now finding it in the Solomons area) being devoted to its history and the documentation of existing specimens.

There is an excellent bibliography and one of the appendices is a guide to the present locations of various collections. This is a revised list based on a previous one by the late C. D. SHERBORN; it should be regarded only as a broad guide because collections are seldom 100 per cent complete when they are finally deposited in national collections.

Space does not permit full consideration of the immense amount of detailed information contained in this fascinating and erudite account; it is obviously the kind of book that is a 'must' for the keen conchologist.

W. J. REES

Sea Shells of the World (with values) by A. GORDON MELVIN. Rutland, Vermont and Tokyo, Japan: Charles E. Tuttle Co., Inc., 1966. Representatives for the British Isles: Prentice-Hall International, Inc., London. pp. 167, including 54 plates, 27 in colour. 8¼" × 5¾". Cloth. Price 60s or U.S. $7.50.

The author describes his book as 'a practical book for shell collectors'; it is arranged as an illustrated catalogue of world-wide shells and gives monetary values. This book may appear to be similar to *Van Nostrand's Standard Catalog of Shells* by WAGNER & ABBOTT (see *J. Conch.* **25**: 363). The *Catalog*, however, is primarily a check-list for the specialist collector, and lists most species from a small number of the most popular genera, with selected species illustrated by line drawings. In contrast, the present work is intended as a manual for identifying specimens and includes some eleven hundred species selected from many genera; all the included species are illustrated on continuous-tone plates. The main criterion for including a shell appears to have been its attractiveness to collectors, and the overall coverage is fairly good. The feature common to both books is the pricing of each species: WAGNER & ABBOTT give two figures (for good and poor specimens) and varieties are priced separately, whereas MELVIN states only one figure. A comparison of values given, for species included in both works, showed close agreement.

The main text of Dr MELVIN's book comprises paragraphs of standard format, each relating to one figured species, and usually facing the relevant plate, which is convenient. The author gives the scientific name, general geographical range, common synonyms (if any), a brief description of the shell, a note such as 'scarce' or 'rare' where applicable, the normal adult size in inches and the estimated value in dollars for a specimen in good condition; common names are also given for some shells. The nomenclature does not follow the latest revisions; related species are placed under well-known generic taxa of wide scope, such as *Cardium*, *Pecten*, *Voluta*, etc.

The shells are illustrated on whole-page plates with usually only one view of each species. The standard of the plates is variable, some being spoilt by unsightly reflections or uneven illumination (Pls. 45 and 53 are extreme examples of this). All but a few of the shells have been photographed on a black background, which makes a pleasant display, but the margins of many are rather indistinct. A few shells were placed on a white background, and several others should have been so treated: *Melongena patula* (Pl. 41, fig. 17) is a notable example, one margin being totally invisible. The tone rendering of the colour plates is not quite perfect, there being a slight brownish cast in the review copy. Most groups appear in at least two separate positions in the book. Those shells for which colour is important are displayed on the first 27 (coloured) plates; the remaining 27 black and white plates illustrate shells for which shape is the main identifying feature. Often, many widely different groups are included on one plate, where the variety of shapes allows a close arrangement of figures. Thus Pl. 26 contains 33 species from 15 assorted genera. Although some of the plates are devoted to a single genus, one has to search to find all the representatives of a given group. This haphazard lay-out is bound to be frustrating when the book is used to identify an unknown specimen.

The book ends with a three-page glossary, a five-page annotated bibliography of shell books of interest to collectors, and a detailed 27-page index. Species are indexed in their alphabetical positions and also beneath the entries for genera; synonyms given in the book are cross indexed. Glazed paper has been used throughout which can cause glare when trying to read the text at some angles. This is sometimes a nuisance when referring to the book alongside one's collection. The reviewer found also that the surfaces of the plates show finger-marks rather badly.

Dr MELVIN aimed at producing a reasonably-priced identification handbook with a world-wide coverage, suitable for shell-collecting enthusiasts; in this I think he has succeeded, despite the technical faults noted previously. This work would make an excellent beginner's manual for someone starting a general collection of marine Mollusca, and it should be some time before he would need to progress to more specialized (and expensive) textbooks.

C. W. Pettitt

Report on the Linnaean Shell Collection by S. Peter Dance. *Proc. Linn. Soc. Lond.* **178**: 1–24, pls. 1–10. Linnean Society of London, 1967.

The Linnaean shells have always been regarded as one of England's cherished possessions, notwithstanding the doubt that has attached to the scientific importance of some of them since Hanley published his *Ipsa Linnaei Conchylia* in 1855. Mr Dance's exhaustive and careful examination adds to the dubiety. Indeed, it reveals a succession of damage, depredation and adulteration that leaves one wondering how much of the collection is Linnaeus's original material and how many of his types it contains. Many sources from which material was obtained are instanced. Carl Linnaeus *filius* apparently made additions from a variety of named sources, but the greatest disaster seems to have been at the hands of J. E. Smith, the botanist who purchased the collection and from whose widow it was purchased by the Linnean Society in 1829. Not only did Smith add to the collection, but evidence is given to show that he also subtracted by giving away some of its content.

The first part of the Report deals with these issues and concludes with an account of the previous studies of the collection, notably by Hanley, E. A. Smith, Roebuck & Taylor (whose report was never published), Kennard & Woodward, S. Savage of the Linnean Society (report also not published) and Henry Dodge of New York (whose massive work was never completed).

Part II deals with (i) Linnaeus's annotated copies of the *Systema Naturae*, 10th and 12th editions, (ii) the possible impact of Linnaeus's *Museum Ulricae*, i.e. his catalogue of the shells and insects belonging to Queen Louisa Ulrica of Sweden, which he had ready for publication four years before the *Systema*, 10th edition, appeared, and (iii) the shell books possessed by or available to Linnaeus. Here again Mr Dance marshals, and in considerable measure unravels, the conflicting accounts of all these matters as recorded by previous writers. Finally, two very useful lists are given, one naming the people who gave Linnaeus shells or information about them and the other showing nearly 270 Linnaean species of which specimens are *not* to be found in the collection.

A perusal of this Report compels admiration for the thoroughness of its content. The uncertainties surrounding the collection may never be resolved and Mr Dance is aware of this—in his own words: 'The interpretation of the material must now be the responsibility of each worker.' Nevertheless, every student of Linnaeana should read this Report and will be grateful to Mr Dance for his masterly contribution to the subject.

Arthur Blok

Schede Malacologiche del Mediterraneo edited by Fernando Ghisotti. Milan: Società Malacologica Italiana, 1964→. 8vo. Price (first 11 Schede) 3,175 lire=*c.* 43s. stg.

This publication, intended to satisfy the need for an up-to-date systematic account of Mediterranean molluscs, is as welcome as it is ambitious. It is virtually an illustrated card index. Each card, individually dated, contains bibliographical references, observations, diagnoses, dimensions and illustrations of a single species, its subspecies and its principal varieties. Main references, each indicated by a letter and a number, are listed on a separate card; the first page of each species card contains a set of squares, each square corresponding to one of the main references, in which the pertinent volume, page numbers and illustrations of the particular species are entered. Principal synonyms and extra references are also added. For some species a distribution map is given.

The most compelling, certainly the most useful, feature of this index is its illustrations. Some of these are in monochrome, others in colour, and there are several views of each species. Measurements or enlargements are given for each illustration: a millimetre scale would have been better. From an artistic viewpoint it would be difficult to fault, but in some respects art appears to have precedence over science, attractive presentation to have more importance than critical evaluation.

Nomenclatural inanities such as '*Erosaria* (*Ravitrona*) *spurca atlantica* Mts. var. *inaequipartita* Mts.' surely have no place in modern systematics? Do the ghosts of MONTEROSATO, PALLARY and COEN, those high priests of the 'var. ex-forma' and 'var. ex-colore', haunt us yet?

In the cards at hand no mention is made of fossil occurrences. It is to be hoped that the rich Tertiary faunas of the countries bordering the Mediterranean, particularly those of Italy and France, will not be neglected; with so many Recent species first described as fossils by BROCCHI, SACCO, BELLARDI and others it is difficult to see how they can be ignored altogether. As this Index is certain to be of service to many persons without a working knowledge of Italian, a translation of the introductory card into one or two more widely-used languages ought to be made available and —to avoid confusion—a recommended bibliographical reference for indicating a particular card would be a useful additional item.

This is a well-produced publication which cannot fail to be useful to malacologists throughout the world; but to succeed it must meet the demands of an audience already accustomed to the high standards of *Indo-Pacific Mollusca* and *Johnsonia*; it is in its infancy yet and can be modified as experience dictates. Meanwhile, all praise to the Italian Malacological Society for initiating a publication dealing with a fascinating molluscan fauna which, for want of accessible literature, has been neglected far too long.

S. PETER DANCE

A Survey and Illustrated Catalogue of the Teredinidae by RUTH D. TURNER. Cambridge, Mass.: Museum of Comparative Zoology, Harvard University, 1966. pp. 1–265, including 64 plates and 25 text-figs. Price U.S. $8.00.

The Teredinidae, or ship-worms, are undoubtedly the most 'difficult' family of bivalves from a taxonomic viewpoint, so it is unfortunate that their great propensity for destroying wooden structures ranks them among the most economically important. These facts have resulted in a proliferation of names and a lack of correlation of work done in different parts of the world. It is only in comparatively recent times that the wide distributional range of many species has been recognized. Dr TURNER's present work goes a lot further than merely bringing some order out of this chaos, for her conclusions have been based on a complete re-evaluation of all available evidence concerning teredinid taxa.

The first part of this work [pp. 1–81] comprises a most readable and lucid survey of the Teredinidae, including a historical account of previous work on the family, a note on fossil teredinids, details of the anatomy in the fourteen genera recognized as valid (the genus *Zachsia* is excluded from consideration owing to lack of material), diagnoses and synonymy of these fourteen genera, and discussions of distribution and dispersal, trends in evolution, and characters used in identification. Part one is concluded with a key to the genera.

The second part begins with a complete alphabetical catalogue of all generic and specific names which have been used in the Teredinidae, with their original references. For each species-group name the type-locality, whereabouts of type-material and the present status of the name are given; for generic-group names the type-species and method of its designation are given. From every name considered valid a cross-reference is given to its synonyms.

About half the book is occupied by 64 plates of superbly-drawn figures together with their explanatory text. Wherever possible, figures of the type-material have been drawn specially for this work; in a few cases, when the type-material was unavailable, copies were made of the original figures. Additional specimens are sometimes illustrated to show the variation within the species and to give evidence as to why some names are considered synonyms. The author makes it quite clear in her text that identification of teredinid species is usually impossible without reference to the pallets, although in some cases (e.g. *Psiloteredo megotara* (Hanley)) characters of the shell are of some diagnostic value. This point is ably demonstrated in Fig. 16 where the variation among individual shells of *Teredo navalis* L. from a single locality is shown to be greater than among shells placed in five different genera! In most cases both the shell and pallets of each nominal species are illustrated in the plates.

The work ends with alphabetical lists of 297 teredinid names subdivided on a geographical basis according to type-localities, and a bibliography of some 176 items. The author states [p. 258] that it is not possible at the present time to list all species capable of reproduction in each geographical region as many species have been recorded only from driftwood. For this reason caution is required when using the geographical lists: nine of the nominal species with type-localities in British waters, for instance, are known warm-water species carried to Europe by ocean currents or wooden ships. An unfortunate error occurs on p. 260 where ten names are misaligned with their synonyms, but an errata slip giving the correct synonymies has been issued. Other typographical errors are remarkably few considering the length and complexity of the text, the only ones of note being '*Ida*' for '*Idas*' [p. 56] and '*Zachia*' for '*Zachsia*' [p. 73 and p. 260].

Of the 297 names listed geographically, only 66 are accepted as good species, and the author admits that several of these may also prove to be synonyms when more material is available for study. No key to species is attempted. This is understandable considering the intraspecific variation and interspecific similarities referred to above. The majority of the figures, however, have been grouped so that synonymous and closely related species are on the same or adjacent plates.

Not only is this *Survey and Illustrated Catalogue of the Teredinidae* essential reading for any worker interested in any aspect of this group, but the excellence of its presentation is such that it sets a standard against which future works of similar scope will be judged.

DAVID HEPPELL

Lakeland Molluscs. *Trans. Carlisle nat. Hist. Soc.* **11**. Carlisle: Carlisle Natural History Society, 1967. pp. 74, frontispiece + 2 pls. Demy 8vo. Durabak cover. Price 10s. Obtainable from the Hon. Editor, ERNEST BLEZARD, 100 Durdar Road, Blackwell, Carlisle, Cumberland.

This volume comprises two papers: 'A preliminary list of the marine Mollusca of Lakeland' by MARJORY GARNETT & MARY M. MILNE [pp. 11–47] and 'Non-marine Mollusca of Lakeland' by ERNEST BLEZARD [pp. 48–68]. The first section lists the marine Mollusca of Cumberland, Westmorland and Lancashire north of the Sands. While admittedly incomplete and dealing almost entirely with littoral species it forms a useful check-list as a basis for future work. The nomenclature and arrangement of the species follows WINCKWORTH's List (1932 and 1951). Most of the 103 species listed are recorded only from empty shells washed up on the beach. This poverty of species, which surprisingly contains no rissoids and only one nudibranch, seems to be due not so much to a lack of local collectors but to the unsuitability of much of the shore line. Shingle or pebble beaches, mud flats and boulder scar predominate throughout much of the area. Even so, there are a few noteworthy records included: a specimen of *Crepidula fornicata* (L.), washed up at Seascale in 1961, is surely the most northerly British record to date of this introduced species, and dead shells of *Petricola pholadiformis* Lamarck, recorded from Haverigg Point, Cumberland, in 1950 are a surprise, as this species is otherwise known in Britain only from the east and south coasts of England. It is also interesting to read that exotic cowries are occasionally washed ashore, probably from a cargo vessel wrecked in 1879. Distribution tables for the 15 subdivisions of the Lakeland area are given [pp. 36–45], the number of species recorded from each ranging from 0 to 67. The two plates illustrate a selection of 42 marine shells, while a stretch of boulder scar is depicted in the frontispiece.

The section on non-marine Mollusca represents only the results of collecting done by the author and his friends. The 65 species listed represent largely the more obvious species and give a poor impression of districts which have a fairly rich fauna (both v.c. 69 and v.c. 70 have over 100 species listed in the Conchological Society's Census). About half the aquatic species known to occur are absent from this list; there are only five slugs and no *Vertigo* or *Vallonia*. It is to be hoped that the author will continue and expand his survey and make good some of the most noticeable omissions. In addition to the indigenous species three adventives are listed. The final six pages are concerned with the food of birds.

DAVID HEPPELL & A. R. WATERSTON

ACCOUNTS FOR THE YEAR ENDING 31 DECEMBER 1966

Income and Expenditure Account

Dr.	£	s.	d.	£	s.	d.
To Annual Subscriptions:						
Paid in 1965	49	15	0			
Paid in arrear	37	7	2			
Current	578	17	1			
				665	19	3
Subscriptions (non-members):						
Paid in 1965	76	11	5			
Current	187	17	6			
				264	8	11
Sales:						
Old Journals (part payment)				500	0	0
Government Stocks				42	0	2
Authors' Separates etc.				29	3	2
Journals, Newsletters and Papers for Students				112	14	8
Donations				12	4	6
From Life Membership Fund				42	0	0
From Dividend Account				150	8	10
Legal Fees recovered				40	12	0
				£1859	11	6

Cr.	£	s.	d.	£	s.	d.
By Publication and Distribution:						
Volume 25, part 8	263	3	8			
Authors' Separates	13	1	2			
				276	4	10
Volume 26, part 1	415	17	11			
Authors' Separates	29	13	0			
				445	10	11
Volume 26, part 2	346	5	11			
Authors' Separates	31	15	0			
				378	0	11
Newsletters				194	16	0
Papers for Students				37	14	2
Subscriptions				6	15	0
Printing and Stationery				85	17	1
Officers' Expenses				50	4	11
Legal Fees				43	15	0
Agenda of Field Meetings				11	9	1
Postages on sales etc.				8	7	2
Excess of Income over Expenditure carried to Balance Sheet				320	16	5
				£1859	11	6

Life Membership Fund

Dr.	£	s.	d.
To Amount of Fund, 31 December 1965	710	0	0
Dividends and Interest from Dividend Account	42	0	0
	£752	0	0

Cr.	£	s.	d.
By Transfer to Income and Expenditure Account	42	0	0
Amount of Fund, 31 December 1966	710	0	0
	£752	0	0

Reserve and Research Fund

Dr.	£	s.	d.
To Amount of Fund, 31 December 1965	1019	0	0
Dividends and Interest from Dividend Account	30	0	0
	£1049	0	0

Cr.	£	s.	d.
By Amount of Fund, 31 December 1966	1049	0	0
	£1049	0	0

Dividend Account

Dr.	£	s.	d.
To 3% Savings Bonds*	1	15	3
4% British Gas Stock	12	14	0
5½% London County Council Mortgage Loan (1965 & 1966)	78	13	0
5⅝% City of Norwich Mortgage Loan	13	4	4
5% Treasury Stock	13	5	0
6¾% City of Birmingham Loan	7	15	4
4½% Defence Bonds*	4	10	0
3½% War Stock*		14	2
4% Funding Loan*	8	3	3
Post Office Savings Bank	1	17	11
National Provincial Bank Deposit Account	21	14	8
Income Tax recovered (1965 & 1966)	58	1	11
	£222	8	10

* These stocks were sold during the year.

Cr.	£	s.	d.
By Transfer to Life Membership Fund	42	0	0
Transfer to Reserve and Research Fund	30	0	0
Transfer to Income and Expenditure Account	150	8	10
	£222	8	10

Balance Sheet

Dr. Liabilities	£	s.	d.	£	s.	d.
To Membership Fees paid in advance				52	9	9
Subscriptions paid in advance				44	3	6
Life Membership Fund				710	0	0
Reserve and Research Fund				1049	0	0
Capital Stock				800	0	0
Balance, 1 January 1966	747	19	11			
Transferred from Income and Expenditure Account	320	16	5			
				1068	16	4
				£3724	9	7

Cr. Assets	£	s.	d.	£	s.	d.
By 5½% London County Council Mortgage Loan at Cost (£800)				769	4	0
5% Treasury Stock (£400)				344	0	0
4% British Gas Stock (£400)				324	10	0
6¾% City of Birmingham Loan				650	0	0
5⅝% City of Norwich Mortgage Loan				400	0	0
Cash:						
National Provincial Bank						
Deposit Account	621	4	8			
Current Account	565	11	9			
Post Office Savings Bank	49	19	2			
				1236	15	7
				£3724	9	7

NOTE: In addition to the Assets shown above are oustanding subscriptions and debts. Under an agreement with the Johnson Reprint Co. the sum of £1155 13s 4d for our stock of old *Journals* is due to the Society. This amount bears interest at 6 per cent and is due to be paid in two instalments on 1 October 1967 and 1 October 1968.

Examined and found correct.

M. MAITLAND HOWARD }
CHARLES W. PETTITT } Auditors.
28 January 1967.

C. A. RAFFRAY,
Hon. Treasurer.
14 January 1967.

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

MEMBERS ELECTED

837th Meeting, 18 February 1967

Mrs Alison M. Esau, 15 Evelyn Road, Ham, Richmond, Surrey.
John L. B. Garcia, m.a., The Priory, Church Street, Godalming, Surrey.
David Charles Long, 59 Bouncers Lane, Prestbury, Cheltenham, Glos.
Mrs J. H. Macartney, P.O. Box 998, Jesselton, Sabah.
Revd R. W. Morrell, b.d., f.g.s., 443 Meadow Lane, Nottingham.
Adrian Jonathan Rundle, b.sc., 29 Burlington Avenue, Kew, Richmond, Surrey.

838th Meeting, 18 March 1967

John Bevan, 210 Havant Road, Drayton, Portsmouth, Hants.
Antony David King, 58 Elsham Road, London W.14.
Mrs E. I. Prebble, Albert Cottage, Binstead Hill, Ryde, Isle of Wight.

839th Meeting, 15 April 1967

David Robert Barwick, ll.b., 18 Grange Road, London N.6.
Mrs Patricia M. Hall, b.soc.sc., 1 Cote Park, Westbury-on-Trym, Bristol 9.
Dr Emilio Rolan Mosquera, Calle Jose Antonio 14–3°, Vigo, Spain.

840th Meeting, 20 May 1967

James Reginald Bollard, 16 Peverell Park Road, Plymouth, Devon.
Miss Kay Carson, 33 Wordsworth Close, Orgill, Egremont, Cumberland.
Peter L. Cresswell, 517 Tweed Street, Invercargill, New Zealand.
Miss Mary M. Milne, 2 Selby Terrace, Maryport, Cumberland.
Mrs Joan C. Raine, 5a Market Street, Bondgate Hill, Alnwick, Northumberland.
Mrs Shelagh M. Smith, b.sc., ph.d., 3 Meadowfield Gardens, Edinburgh 8.

MEMBERS DECEASED

Hamilton Ernest Quick, m.b., b.s., b.sc., f.r.c.s.
William James Rees, d.sc.
Robert Rendall.
Richard J. Turner.

ANNUAL REPORTS

Presented to the 837th (Annual General) Meeting, held at the British Museum (Natural History), 18 February 1967

Mr S. P. Dance, President, in the Chair.

Appointment of Scrutineers

Mr C. W. Pettitt and Miss A. Fullick were appointed Scrutineers.

Election of Auditors

Miss M. Maitland Howard and Mr C. W. Pettitt were elected Auditors.

Report of the Council

MEMBERSHIP. At the beginning of 1966 the Society's subscription was raised to £2 and it might be thought that this fact would have had its due effect on the Membership figures. As it was, fifty-two Members were elected during the year, fifteen resignations were received, eight Members were removed from the roll in accordance with Rule 5, and the Society has lost one, Dr LANG, by death. Coincidentally, all these figures are the same as those recorded last year. The total Membership is now 374, a net gain of 28, of which sixteen are Life and four are Honorary Members of whom one, Mr C. A. RAFFRAY, was recently so created by Council in acknowledgment of his exceptional services to the Society in the Office of its Hon. Treasurer for the past nine years.

MEETINGS. One annual general meeting and seven ordinary meetings have been held at the British Museum (Natural History), by kind permission of the Trustees, the average attendance being over 45 as against 41 last year and 37 the year before.

PUBLICATIONS. The *Journal of Conchology*, commencing a new volume in quarto format, was published as Vol. 26 No. 1 (dated March 1966) on 15 April, and No. 2 (dated June 1966) on 29 July. Of the *Conchologists' Newsletter*, issues were made in March, June, September and December; *Papers for Students* No. 7 was issued in May. The Society also published [as *J. Conch.* **25** (Supplement), issued with Vol. 26 No. 2] a Supplement to the British non-marine Census List, bringing it completely up to date, and this is now available to all. The reprinting of the more important back-numbers of the *Journal*, including the Non-marine Census number, has been completed by the Johnson Reprint Co., and the Society's stock of back-numbers of the *Journal* has been sold to the same firm, except those for Vols. 25 and 26, most of which remain with the printer. Full details were published in *Newsletter* No. 18. Members should order their back-numbers through the Hon. Secretary but will be invoiced by the Company.

TRUSTEES. The lawsuit which was unfortunately necessary for the recovery of some of the Society's funds from its former Trustee has been satisfactorily terminated, largely through the efforts of its two currently appointed Trustees.

PUBLICITY. The Council is having the Prospectus revised and reissued in up-to-date form, and it is hoped that a film of the Society's activities will soon be produced. A joint meeting with the Malacological Society of London was held on 28 January, and was generally regarded as very successful.

Recorder's Report: non-marine Mollusca

A. 10-KILOMETRE SQUARE MAPPING

During the past year the pace of recording has sharply accelerated and I am most grateful to everyone who has contributed. About 10,000 new 10-kilometre square records have been received and incorporated, bringing the post-1950 total up to about 23,000 (I estimate that at least 140,000 records—an average of about 40 per 10-kilometre square—are needed before the printing of maps for the common species can begin.). The most serious difficulty still remains Ireland, where very few conchologists live, and I appeal once more to anyone who may be visiting that country to do what recording they can, or even to send me boxes of un-named, localized specimens.

A map showing the progress of recording will henceforth be published at regular intervals in the *Newsletter*. The first such map appears in No. 20, March 1967, p. 137.

B. VICE-COUNTY RECORDS

A surprisingly large number of new vice-comital records have been verified since the last Recorder's report (*J. Conch.* **26**: 209), reflecting the interest aroused by the mapping scheme. The list is as follows:

Cornwall West (1): *Milax budapestensis*, Reskadinnick (garden), Mrs S. M. TURK, July 1962.
Cornwall East (2): *Planorbis contortus*, *Segmentina complanata*, Liskeard, Mrs J. A. PATON, June 1966.
Devon North (4): *Vallonia pulchella*, Braunton, R. E. BAKER, 1966; *Agriolimax caruanae*, Braunton, J. B. HALL, April 1964.

Wilts North (7): *Pisidium personatum*, Roundway, M. P. KERNEY, September 1966; *Pisidium hibernicum*, Kennet & Avon canal, Little Bedwyn, M. P. KERNEY, November 1966.

Wilts South (8): *Hygromia subrufescens*, Farley, J. A. CARMAN, July 1966; *Oxychilus helveticus*, Chilmark, Mrs J. A. PATON, June 1966; *Oxychilus draparnaudi*, Devizes, M. P. KERNEY, September 1966; *Pisidium milium*, *Pisidium pulchellum*, Stratford Tony, J. A. CARMAN, August 1966; *Pisidium hibernicum*, Kennet & Avon canal, Little Bedwyn, M. P. KERNEY, November 1966.

Hants North (12): *Anodonta complanata*, *Pisidium tenuilineatum*, R. Whitewater, Bramshill, J. B. HALL, May 1966; *Pisidium personatum*, Burghclere, J. B. HALL, April 1966.

Sussex West (13): *Agriolimax caruanae*, Worthing (garden), Miss JUNE CHATFIELD, July 1966; *Pisidium supinum*, *Pisidium moitessierianum*, R. Arun, Greatham Bridge, M. GOODCHILD, July 1966.

Kent West (16): *Pisidium pulchellum*, Shoreham, M. P. KERNEY, October 1964.

Essex South (18): *Oxychilus draparnaudi* (garden), *Vallonia excentrica*, Leigh-on-Sea, R. FRESCO-CORBU, 1964; *Hygromia liberta*, Little Baddow, *Pisidium hibernicum*, Ulting, both R. FRESCO-CORBU, 1966.

Essex North (19): *Limax marginatus*, Felsted, M. P. KERNEY, February 1967.

Bucks (24): *Milax budapestensis*, Little Kingsmill (garden), J. G. EVANS, October 1965.

Norfolk East (27): *Zonitoides excavatus*, Witton Wood, C. W. PETTITT, July 1966.

Norfolk West (28): *Pseudamnicola confusa*, *Planorbis laevis*, Thornham, D. S. DAVIS, August 1960.

Cambridge (29): *Arion subfuscus*, Hatley St George, C. R. C. PAUL, June 1966.

Worcester (37): *Succinea putris*, *Vertigo substriata*, Caunsall, Cookley, J. B. HALL, May 1966; *Arion lusitanicus*, Harborne, Birmingham, G. H. HARPER, July 1966.

Glamorgan (41): *Lauria anglica*, Llanmadoc, D. H. DALBY, April 1963.

Caernarvon (49): *Azeca goodalli*, Great Ormes Head, J. R. LE B. TOMLIN, April 1920 (this record was previously wrongly ascribed to v.c. 50); *Milax gagates*, *Agriolimax caruanae*, garden of lighthouse, Bardsey Island, G. H. HARPER, August 1966.

Lancaster West (60): *Milax budapestensis*, Woodplumpton, Mrs M. FOGAN, August 1966; *Agriolimax caruanae*, Fulwood, Preston (garden), E. GREENWOOD, October 1966.

York South-east (61): *Planorbis laevis*, Hornsea Mere, *Vallonia excentrica*, Beverley, *Vallonia pulchella*, *Milax gagates*, *Milax budapestensis*, Hull, all A. NORRIS, 1966; *Zonitoides excavatus*, *Milax sowerbyi*, Bridlington, G. WHITFIELD, June 1966; *Agriolimax caruanae*, North Ferriby, A. NORRIS, February 1967.

York South-west (63): *Helicella caperata*, Thorne, A. NORRIS, January 1966; *Agriolimax caruanae*, Farnley Hall, Leeds, J. ARMITAGE and A. NORRIS. March 1966.

York Mid-west (64): *Arion lusitanicus*, Hanover Square, Leeds, J. ARMITAGE and A. NORRIS, November 1966; *Vitrea subrimata*, Austwick, Mrs M. FOGAN, August 1966; *Oxychilus draparnaudi*, Knaresborough, J. ARMITAGE and A. NORRIS, March 1966.

Cumberland (70): *Phytia myosotis*, Grune Point, Skinburness, E. BLEZARD, August 1966; *Milax budapestensis*, Blackwell (garden), E. BLEZARD, January 1964.

Isle of Man (71): *Planorbarius corneus*, Langness, Castletown (probably introduced in 1920's), Miss L. S. GARRAD, February 1967.

Kircudbright (73): *Helicella caperata*, Brighouse Bay, Borgue, A. McG. STIRLING, April 1964.

Renfrew (76): *Succinea putris*, Castle Semple Loch, F. R. WOODWARD, July 1966.

Peebles (78): *Pisidium lilljeborgii*, Gameshope Loch, D. K. KEVAN, May 1936.

Selkirk (79): *Pisidium lilljeborgii*, Akemoor Loch, D. K. KEVAN, May 1936.

Stirling (86): *Vertigo pusilla*, Abbey Craig, Stirling, W. EVANS, October 1901 (this record was previously wrongly ascribed to v.c. 87).

Banff (94): *Agriolimax agrestis*, *Pisidium milium*, Braco Burn, north of Keith, *Pisidium obtusale*, Knock, all E. KELLOCK, November 1966.

Elgin (95): *Valvata cristata*, *Pisidium milium*, Brodie Pond, Forres, *Planorbis albus*, Loch of Blairs, Altyre, *Succinea pfeifferi*, Loch Spynie, *Hygromia hispida*, Elgin and Burghead, *Helicella caperata*, Inverugie (confirmation of old record from this place), *Zonitoides nitidus*, Wester Newforres, *Limax tenellus*, Kellas, *Pisidium personatum*, Roseisle Forest, all I. D. FINNEY, 1965–66.

Easterness (96): *Phytia myosotis*, Whiteness Head, Nairn, L. LLOYD-EVANS, July 1966; *Physa fontinalis*, Loch Garten, Nethybridge, *Planorbis laevis*, Loch Flemington, Nairn, *Lauria anglica*, Cothill, Nairnshire, all I. D. FINNEY, 1966.

Kintyre (101): *Potamopyrgus jenkinsi*, Crinan canal (south side), Bellanoch, D. K. KEVAN, June 1960.

Ross East (106): *Acanthinula aculeata*, *Hygromia striolata*, Fairy Glen, Rosemarkie, I. D. FINNEY, August 1966.

Sutherland East (107): *Retinella nitidula*, Strathbrora, I. D. FINNEY, April 1966.

Sutherland West (108): *Hydrobia ulvae*, Kyle of Durness, L. LLOYD-EVANS, July 1966.

Caithness (109): *Helix aspersa*, Scrabster, Thurso (gardens), A. D. J. MEEUSE, July 1966; *Hygromia striolata*, *Milax budapestensis*, Castletown (on rubbish), I. D. FINNEY, September 1966.

Orkney (111): *Hydrobia neglecta*, Oyce of Isbister, Mrs M. FOGAN, June 1966; *Vertigo lilljeborgi*, by Loch of Skail, *Hygromia striolata*, Burray, both A. D. J. MEEUSE, July 1966.

Tipperary North (H 10): *Potamopyrgus jenkinsi*, Lough Derg, south of Portroe, Miss MARY PUGH, July 1966; *Vertigo pusilla*, Borris Wood, Borrisokane, EDWARD WALLER, *c.* 1850 (*Nat. Hist. Review* **1**: 86 (1854)), specimens in Dublin Museum determined by A. W. STELFOX, 1920.

Kilkenny (H 11): *Pisidium moitessierianum*, R. Barrow, Graiguenamanagh (living), R. A. PHILLIPS, March 1924 (from PHILLIPS MS.).

Roscommon (H 25): *Pisidium moitessierianum*, R. Suck near Ballinasloe (living), R. A. PHILLIPS, *c.* 1930 (from PHILLIPS MS.).

Cavan (H 30): *Zonitoides excavatus*, Cuilcagh Mountain, A. W. STELFOX, July 1909.

Fermanagh (H 33): *Milax budapestensis*, *Agriolimax caruanae*, Ballinamallard (garden), Mrs A. GRAHAM, June 1966.

Antrim (H 39): *Milax budapestensis*, Whitepark Bay (garden), C. B. GOODHART, April 1962; *Agriolimax caruanae*, Dunmurry (garden), Mrs A. GRAHAM, June 1966.

The following segregates have also been verified:

Carychium minimum: 8, 15, 25, 70, 94, 96, 109, 111.
Carychium tridentatum: 70, 71, 94, 109, 111, H 1, H 6, H 9.
Cochlicopa lubrica: 7, 8, 24, 25, 30, 48, 58, 63, 66, 71, 94, 109, 111, H 3, H 6, H 19, H 21.
Cochlicopa lubricella: 18, 22, 25, 62, 66, 67, 68, 71, 86, 94, 95, 106, 109, H 1, H 9.
Vitrea crystallina: 7, 8, 14, 15, 18, 25, 93, 94, 106, 109, H 9.
Vitrea contracta : 27, 71, 78, 93, 94, H 7.
Arion ater rufus: 8, 14, 58, 60, 64, H 9.

The following records are to be deleted from the Census:

Huntingdon (31): delete *Pomatias elegans*. The record published in the 1951 Census is probably due to a printer's error: it does not appear in the Census notebooks, and in any case there are few or no suitable habitats for this species within the county.

Warwick (38): delete *Clausilia rolphii* ('unconfirmed'). The record is based on a specimen found in 1881 by a canal wharf at Bearley, on timber which had probably come from Gloucestershire.

Perth West (87): delete *Vertigo pusilla*. See note under Stirling (86) in list above.

Galway West (H 16): delete *Succinea oblonga* ('unconfirmed'). The record is based on specimens from the Aran Islands, which are in Clare (H 9).

By far the most interesting record of the year, and a new addition to the British fauna, is the discovery by Mrs M. FOGAN of *Vitrea subrimata* Reinhardt near Austwick, Yorkshire. *V. subrimata* has an alpine–Central European range. It may easily be distinguished from our two common species of *Vitrea*, *V. crystallina* and *V. contracta*, by having an extremely minute umbilicus (EHRMANN, 1933. *Tierwelt Mitteleur.* **2** (Mollusca): 92, fig. 60). An illustrated account is being prepared for the *Journal*.

The discovery of the true *Agriolimax agrestis* in Banff is the first record for the Scottish mainland. The species has in the past been confused with the ubiquitous *A. reticulatus*, and may well turn out to be widespread in the northern parts of Britain. *Hydrobia neglecta*, now recorded from Orkney, may also be expected at many more sites in the British Isles.

The records of *Helix aspersa* and *Milax budapestensis* from Caithness, and of *Hygromia striolata* from Ross East, Caithness and Orkney, considerably extend the known northern ranges of these synanthropic species; judging from their restriction to disturbed habitats, it seems probable that they are being actively spread by man in Scotland.

Other noteworthy additions are *Valvata cristata*, *Hygromia hispida* and *Limax tenellus* from Elgin, *Pseudamnicola confusa* and *Planorbis laevis* from Norfolk West, *Vertigo lilljeborgi* from Orkney, *Arion lusitanicus* from Worcester and York Mid-west, *Arion ater rufus* from Clare (the first Irish record), *Zonitoides excavatus* from Norfolk East, and *Pisidium tenuilineatum* from Hants North.

M. P. Kerney

Recorder's Report: marine Mollusca

In February 1966 I took possession of the various items connected with the Marine Census over the past 40 years. This consisted of:

1. 600 copies of the Winckworth Census Maps—one for each species.
2. Numerous lists of species, with notes as to which records had been checked and which were represented in the Voucher Collections: the total number of species thus listed I estimate to lie between 3,000 and 4,000.
3. Five foolscap notebooks designed for writing up detailed records.
4. A card index started in 1962 on which *c.* 1,000 abbreviated records had been entered, card colour indicating whether records were based on live specimens or shells, and whether they were in the Central Voucher Collection at the British Museum (Nat. Hist.), a Regional Voucher Collection or a Private Collection: only 'vouched' specimens, i.e. those whose whereabouts were reasonably assured, had been entered.

It was obvious, as the two previous Recorders had stated, that the value of the Map records was very limited. Many had no locality data so they could not be transferred to the correct Marine Census Area as drawn up under the 1961 scheme now adopted, which subdivides Winckworth's original 20 areas into 40. Moreover, it was not always clear whether the records were based on the live animal or shell alone, and very few were dated. Some of these records have, in fact, been salvaged and incorporated in the present recording system, but even these will be supplemented with examples bolstered with more data as and when possible.

With the approval of the Marine Census Subcommittee, the basic method of recording adopted by Mr Heppell has been continued in modified form. Not being satisfied that the notebooks would allow for later growth, or that the cards allowed sufficient room for the data required, I have commenced logging records in detail on loose-leaf foolscap sheets kept in a series of ring files.

The precise position of the records to date is as follows: 600 sheets of lined foolscap paper have been headed with the name of each species in a manner allowing of later emendments, whilst seven ruled columns on the left-hand side contain the following key information, followed by as much data on ecology, locality and behaviour as may be submitted by correspondents:

CA: number of Census Area.
Aa: recorded live, this century (A) or last (a).
Bb: record based on shell only, this century (B) or last (b).
Cc: record based on worn shells or valves, this century (C) or last (c).
Dd: doubtful record, this century (D) or last (d).
R: species seen by the Recorder, recognized Referee or someone considered by the Recorder to be competent to identify particular species. (Names of people responsible for determinations are included in the general data.)
V: examples in Central Voucher Collection, BM(NH). (Although collectors' names are always added to the data with an additional note if they are known to have been donated to another collection, it is obviously difficult to guarantee that they will be kept in any one private collection for very long, let alone permanently. However, all lists of species are kept for future checking and re-tracing if the need arises. Each Census Area has its own folder, hence the growing importance of submitting records already separated into Areas.)

So far approximately 3,000 records have been entered by the above method: these are from the accumulated lists, and batches of shells sent for checking during 1966. The prototype recording form reproduced in the *Conchologists' Newsletter* for June 1966 (No. 17) is being used by several correspondents and is proving a great help in keeping full and easily traced records.

Corner stones for the Census are provided by the various recent Marine Faunas, extracts from which will eventually be added to the file sheets. Obviously people helping with records are less likely to submit new finds from Areas which include a focal point of intensely worked ground, and are therefore advised to search in the light of information contained in such faunal lists. The Areas covered or partially covered are as follows:

CA 3. Orkney: RENDALL, R., 1956. Mollusca Orcadensia. *Proc. R. Soc. Edinb.* (B) **66**: 131–201.

CA 18. West Channel: MARINE BIOLOGICAL ASSOCIATION, 1957. *Plymouth Marine Fauna*, ed. 3. Plymouth.

CA 21. Bristol Channel: CROTHERS, J. H. (Editor), 1966. Dale Fort Marine Fauna. *Field Studies* 2 (Supplement).

CA 26. Isle of Man: BRUCE, J. R., COLMAN, J. S. & JONES, N. S., 1963. Marine Fauna of the Isle of Man and its surrounding seas, ed. 2. *LMBC Memoir* No. 36. Liverpool University Press.

CA 29. Clyde and Argyll: ALLEN, J. A., 1962. Mollusca. *Fauna of the Clyde Sea Area.* Millport: Scottish Marine Biological Association.

By contrast the recent information about most other areas is very scanty. However, at least it is now becoming possible to let Members have some approximate indication of what has already been recorded and which species need 'up-grading' (from C to B or A) in any particular Area where they plan to do shore work.

The intensifying of interest in British marine molluscs resulting from the National Census gives a unique opportunity for observing and noting aspects of the ecology and behaviour of the living animal as well as its presence in a particular Area. The need for such information is obvious to anyone consulting the habitat and distribution list in FRETTER & GRAHAM's *British Prosobranch Molluscs* (1962): many species have the note 'habitat unknown', 'breeding unknown', 'distribution unknown'. TEBBLE (1966) in *British Bivalve Seashells* also stresses the ignorance we have of the distribution of even common species. Helping to build a bank of ecological and behavioural observations is, in the present Recorder's view, a very important part of the compilation of the Census records.

It will be seen from the basic statement in this Report that the Marine Census work still has enormous lee-way to make up. The promise remains to produce a provisional Census list for circulation as soon as possible, using abbreviations on the lines indicated above, but many more thousand records must first be logged if this is to be worth the paper it will require and the cost of duplication. I fully believe that if Members realized the extent to which they could help they would enjoy adding to the national collection of *records* as much as they enjoy finding a new *shell* for their private collection. For instance, a complete beginner in the study of marine molluscs recently handed me a few dozen shells gathered from the shore near Deal, Kent: no less than 18 new records for CA 13 were included (2A, 9B and 7C). He intends to re-visit the Area, searching for other species and up-grading the existing records where possible. Special thanks must be given to the loyal supporters who do in fact equate the build-up of their own collections with maximum help for the Census, and even arrange their holidays accordingly.

STELLA M. TURK

Field Meetings

Ten field meetings were held during 1966 as follows: 13 March, Cleeve Hill, Gloucestershire; 2 April, Box Hill, Surrey; 17 April, Barnes Bridge, London S.W.13; 1 May, Folkestone, Kent; 3 July, Orford, Suffolk; 17 July, Pevensey, Sussex; 7 August, Bledlow, Buckinghamshire; 10 September, Burnham-on-Crouch, Essex; 1 October, Buntingford, Hertfordshire; 16 October, Sonning Common, Oxfordshire. In addition to these the following meetings were organized by the North-West Mollusca group: 30 April, Plumley Nature Reserve, Cheshire; 7 May, Warrington, Lancashire; 14 May, Marple, Cheshire; 21 May, Pendleton, Lancashire; 23 July, Earlestown, Lancashire; 30 August, Upton, Cheshire; 1 September, Middlewich, Cheshire; 3 September, Congleton, Cheshire; 8 October, Parbold, Lancashire. Thanks are due to the following for leading these meetings: Miss J. ROYSTON, Miss J. E. CHATFIELD, Mrs M. FOGAN, Miss E. FOGAN, Dr D. A.

Hancock, Dr B. Verdcourt, Messrs M. R. Block, S. P. Dance, A. E. Ellis, R. A. D. Markham, P. E. Negus, D. G. Pickrell, J. A. Willson, J. H. Cooper-Pool, G. Whitfield, W. F. Edwards and J. O'N. Millott.

Details of these field meetings are published in the Society's *Newsletter*. Field meetings are also held by the Society's Yorkshire branch.

In order to extend the range of these activities it is proposed to try two-day field meetings during the 1967 season, together with one in the Leicester area at which it is hoped that Members from both north and south will be able to take part jointly for the first time.

T. Pain

Report on Junior Membership for 1966

Junior Membership in the Society increased by four during the year, having gained six new Members and lost two by resignation. The present total Membership is twenty-seven.

Owing to limitations of finance, only one paper in the series *Papers for Students* was published, namely No. 7 by Mrs Stella M. Turk, F.Z.S.: 'Literature on British Molluscs' (12 May). This paper consisted of fourteen pages and was the longest in the series so far. It is encouraging to note that besides the free distribution of these papers to Members of the Society, more than £10 worth have been sold to non-Members. Quite a number have been purchased by students in Colleges of Education etc., and some have gone as far afield as the U.S.A. and South Africa.

Another interesting development is that during this year there has appeared the first communication by a Junior Member to the *Conchologists' Newsletter* (B. M. Thistleton in No. 19).

H. E. J. Biggs

Curator's Report

The past year, 1966, has been marked by the addition of many specimens of slugs to the Voucher Collection. Most of these have been dissected and identified by Mr A. E. Ellis and thus authenticated records of some of the more critical species are especially useful. In some genera, Voucher specimens may be of considerable future use, outstanding of which is the *Arion circumscriptus* complex consisting of different forms which await publication by Dr H. W. Waldén. The Voucher Collection is essentially for the preservation of new vice-county records but well localized specimens of rare or local species and spirit specimens of slugs are of value. As the identification of several critical species of pulmonates is based on the reproductive system, specimens preserved in alcohol allow dissection of the animal in addition to examination of the shell. Once again we are grateful to the enthusiasm of several Members for the new additions to the Voucher Collection.

June E. Chatfield

Votes of Thanks

Votes of thanks were approved to the Trustees of the British Museum (Natural History) for the continued use of the Board Room, to the Officers and Council of the Society, and to those Members good enough to carry out the tea arrangements.

Presidential Address

The President delivered an address entitled 'The Voyages of Captain Cook and their impact on Conchology'.

Election of Officers and Council

The Officers and Council were declared elected, as shown on p. 151.

JOINT MEETING OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND AND THE MALACOLOGICAL SOCIETY OF LONDON

A joint meeting with the Malacological Society was held in the Insect Gallery and lecture theatre of the British Museum (Natural History) on Saturday 28 January 1967, and was the first full-scale meeting of the two societies. The venture was enthusiastically supported by 72 members of both societies and 28 guests who gathered for sherry and refreshment at 11.00 a.m. in the Insect Gallery where the exhibits were on display.

At 11.15 Mr Arthur Blok gave a welcoming address to all present and pointed out that the meeting was in fact the second joint meeting, the first having been a modest lunch-time gathering in the Piccadilly Grill on 5 September 1945, to celebrate the 81st birthday of the famous conchologist J. R. le B. Tomlin. Mr Blok paid tribute to the publications justifying the separate existence of the two societies and expressed the hope that both might continue, in mutual harmony, to add to knowledge in their common field of the study of the Mollusca in all its aspects.

The programme of the meeting consisted of five lectures with time at the beginning of the morning and in the afternoon for exhibits and informal discussion. The Chair was taken during the morning session by Dr Vera Fretter (President of the Malacological Society) and during the afternoon by Mr S. P. Dance (President of the Conchological Society).

The meeting was concluded at 5.50 p.m. when Mr S. P. Dance expressed gratitude to the Trustees of the British Museum (Natural History) for allowing the use of the Insect Gallery and lecture theatre, to Mr A. Blok for opening the meeting, to Mr J. F. Peake for operating the projector, to the ladies who organized refreshments, to the five speakers, Professor J. E. Morton, Dr E. R. Trueman, Mr D. Heppell, Dr B. C. Clarke and Mr R. P. Scase, and finally to the subcommittee, Dr Elizabeth B. Andrews, Miss June E. Chatfield, Mr C. P. Castell, Mr P. E. Negus, Mr C. P. Nuttall and Mr J. W. Stephenson, who organized the meeting. Dr Anna M. Bidder then proposed a vote of thanks to the two chairmen, Dr Vera Fretter and Mr S. P. Dance.

June E. Chatfield

ABSTRACTS OF LECTURES

NICHES AND HABITATS AMONG THE MOLLUSCS

It is commonly assumed that very similar animals occupying the same area must be doing something a little different to keep them from direct competition. By this concept we get the idea of an ecological niche, that is to say a 'niche' in the sense of a role in the community. A foothold is obtained by exploiting the environment in a different way from possible competitors. These distinct relationships with the environment may often involve diet and feeding habits, but it is a mistake to equate ecological niches simply or directly—as is often done—with places in the food chain or meshes in feed web. It is true that many animals, particularly in some groups of molluscs, are diet specialists. Others appear to obtain a complex and highly adapted 'fit' with their surroundings, not by diet but by resembling the background as if in camouflage: using the ground topography for protection, lying close to the substratum, withdrawing into crevices or boring holes in it. All these diversities of habit may bring into being separate ecological niches. The niche idea simply expresses the circumstances in which a population can get a living in its surroundings without eventually succumbing to competition from another species.

Three categories of ecological niche are discussed among the Mollusca: dietary niches, spatial or topographic niches, and temporal or seasonal niches. But it is not to be thought that any of these are exclusive categories, or that they lend themselves suitably to rigorous classification. Dietary niches often call for beautiful and elegant adaptations. They reach their culmination at that connoisseur's level of gastropod adaptation, the Opisthobranchia; with a suctorial grazing on attached surface animals, or feeding on plant tissues, these sea slugs and their relatives are often very diet specific. The Sacoglossa feed upon the fluid cell contents of green algae. The dorids are sponge grazers; pleurobranchids feed on ascidians. The Dendronatacea feed generally upon coelenterates, and the aeolidiids carry this habit further with the storage of undischarged nematocysts. In the families Pyramidellidae and Eulimidae are comprised a huge contingent of tiny, shelled suctorial ectoparasites.

Spatial and topographic niches seem to be most emphasized in those molluscs such as bivalves that take a uniform diet of particulate material by processes of ciliary filtering. Here it would not appear that choice of food is critical, or even very important in the establishment of the niche. We must look at the bivalves in terms of their parcelling up of the substratum and the types of physical relation they bear to it, as in the depth and nature of the burrows they make, or the attachments they establish. The spatial relation of bivalves to the substratum is of major interest also to palaeontologists and palaeoecologists; indeed there would appear to be a number of broad patterns of adaptive form among bivalves, and within these patterns again many subsidiary patterns, often of parallel evolution repeated many times. The various bivalve 'facies', whether donacid, cardiid, carditid, macomatid, tellinid, myid, pholadid, or whatever it may be, appear to have little relation to type of food, but rather to accommodation in and movement through the substratum.

The third category of niche, that depending on temporal and seasonal separation, can be illustrated from among the wide assembly of surface-dwelling archaeogastropods that feed by grazing and scouring up whatever the substrata may have to offer, inorganic remains, diatoms, or even the bacterial or algal films of sand grains. Such molluscs do not appear to occupy rigid dietary or spatial niches. We find, for example, many species of limpets and top shells living mingled together and maintaining their separateness by reproductive isolation, often by keeping their breeding seasons apart in time. There may be two sorts of adaptations for such isolation, widespread simultaneous spawning, and strong segregation in the season and even in the time of day between the spawning of related species. The use of seasonal isolation to bring about the existence of a separate 'niche' will ensure immunity from competition at the critical reproductive stages where species might otherwise be specially vulnerable. Recent work on limpet species has been cited to illustrate this principle.

John Morton
University of Auckland, New Zealand

THE MECHANISM OF BURROWING IN BIVALVIA

The process of burrowing in the Bivalvia has been studied by analysis of cine film and by electronic recording techniques. Burrowing consists of a step-like series of movements, each termed a 'digging cycle', involving the integration of the muscular system of the whole body, which continues until a stable position in the substrate is attained. The digging cycles of representative genera, e.g. *Tellina*, *Donax*, *Macoma* and *Cardium* were exhibited on film and consist of the following stages.

1. The foot makes a major probe downwards.
2. Siphons close, preventing water from passing out at adduction (3). Pedal dilation may commence.
3. Adduction occurs, forcing a jet of water from the mantle cavity (which loosens the adjacent sand) and blood into the foot which becomes swollen and ensures a firm pedal anchorage prior to retraction.
4. Contraction of first the anterior and secondly the posterior retractor muscles, resulting in the shell being pulled into the sand by a rocking movement.
5. Valves and siphons re-open.
6. Foot is extended by successive probes.

These continue until the next cycle occurs. During this period the animal is held in the sand by the valves pressing outwards by means of the opening thrust of the ligament.

The digging process consists essentially of the repeated adduction and re-opening of the valves integrated with protraction and retraction of the foot. Adduction accomplishes a pedal anchor so that the shell may be drawn down; the ligament strength gives rise to a shell anchor which prevents the animal from being thrust upwards as the foot probes down.

E. R. Trueman
Department of Zoology, The University, Hull

JOHN GWYN JEFFREYS

Gwyn Jeffreys was born at Swansea on 18 January 1809. His early interest in Natural History was fostered by L. W. Dillwyn and by his headmaster, Mr Griffiths. Jeffreys practised as a solicitor in Swansea until 1856, in which year he was called to the Bar. He then lived in London for a number of years but later gave up his practice to enable him to devote all his time to the study of the Mollusca. Jeffreys has been called the 'Father of British dredging' and he was certainly one of the first to dredge the British seas systematically, first in his own yacht the 'Osprey' and later on government-sponsored expeditions. The most important of these were the 'Porcupine' cruises of 1869 and 1870, which discovered a large number of new species and species previously known only as Tertiary fossils. Dredging was successfully accomplished at greater depths than ever before, and the prevalent ideas of a maximum depth below which life could not exist were shown conclusively to be false. Besides the very important material amassed by his own efforts, Jeffreys's collection was enriched with the acquisition of those of Turton, Clark and Weinkauff, and type-material from many other conchologists. In addition he built up an extensive collection of Tertiary and post-Tertiary shells of Europe. All this was intended for the British Museum but, as a result of a disagreement with those in authority there, the entire collection was sold to the Smithsonian Institution, Washington, for £1,050, a few years before Jeffreys's death. Jeffreys's publications amounted to nearly 200 works, of which the most important are the 5-volume 'British Conchology' and a series of papers on the Mollusca of the 'Lightning', 'Porcupine' and 'Valorous' expeditions. He remained actively engaged on working out the results of the 'Lightning' and 'Porcupine' expeditions right up to the time of his death, which occurred suddenly at his home in Kensington, London, on 24 January 1885.

David Heppell
Royal Scottish Museum, Edinburgh 1

STUDIES ON THE PARTULAE OF MOOREA

In the summer of 1962, Dr J. J. Murray and I spent three months on the island of Moorea in French Polynesia. We studied the population genetics of land snails of the genus *Partula* Férussac. Crampton (1932) and Crampton & Cooke (1953) have described eleven species from the island. Two of these species (*P. solitaria* Crampton and *P. diaphana* Crampton & Cooke) were described from single, possibly aberrant, examples. *P. dendroica* Crampton is an allopatric replacement of *P. suturalis* Pfeiffer and probably deserves only the rank of geographical race, since the two forms mate freely in the laboratory. It is likely that *P. tohiveana* Crampton and *P. olympia* Crampton are similarly geographical races of *P. mooreana* Hartman. We found evidence of natural hybridization between *P. aurantia* Crampton and *P. suturalis*, and between *P. exigua* Crampton and *P. taeniata* Mörch. There are apparently only four good 'biological' species on the island.

The genetics of colour and banding varieties in *P. taeniata* and *P. suturalis* have been determined (Murray & Clarke, 1966). In *P. taeniata* the distribution of purple shells shows 'area effects' similar to those described in *Cepaea* by Cain & Currey (1963). I have suggested (Clarke, 1967) that these patterns may be determined as much by the internal genetic environment as by the external ecological environment. Some support for this hypothesis was obtained from transects through the steep morph-ratio clines between areas.

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Bryan Clarke
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VOLUTIDAE

Volutes are carnivorous and active animals frequently burrowing in sand or mud, and whilst a great number are found on coral reefs many are from deep water. Some are operculate but the majority have no operculum. The eggs are laid in clusters and there is no free-swimming larval stage, so that there is a tendency for local populations to develop their own characteristics.

About 210 species of living Volutidae are known and they have been split into about fifty genera, each consisting of only a few species, and this probably indicates that they are nearing the end of their evolution. Many fossil species are known and they are frequently found in the Barton Beds.

Coloured slides of volutes representing about 100 species were shown to illustrate variety of form and species from different geographical regions. Many of these species were from Australia and included some interesting rarities.

R. P. Scase
Royal Horticultural Society's Garden, Wisley, Woking, Surrey

EXHIBITS

Mr J. Armitage and Mr A. Norris (Vity Museum, Leeds): an illuminated address* presented by the Conchological Society to J. W. Taylor on the occasion of his 70th birthday, originally painted by the exhibitor, Mr J. Armitage, and now in the City Museum, Leeds; sinistral land and fresh-water molluscs and darts of Helicidae and Zonitidae (from the F. Taylor collection); sinistral *Lymnaea peregra* (Müller) from King Lane Pond, Leeds, 1901–04 (Nelson collection); sinistral subfossil *Helix nemoralis* L. from Donegal (A. G. Stubbs collection); living *Arion lusitanicus* Mabille from the only known locality in Leeds.

Mr E. C. Badcock: golden marine gastropods; *Nerita* and *Neritina*.

Revd H. E. J. Biggs: molluscs from archaeological sites.

Dr E. O. Bishop: land molluscs from Ibadan, W. Nigeria, 1966, including living *Archachatina marginata ovum* (Pfeiffer).

Mr A. Blok: *Polymita picta* (Born); species of *Gulella*; an MS. catalogue of shells offered for sale in London, 5 August 1763 (author unknown); original drawings of plates and figures published in *Proc. malac. Soc. Lond.*, vols. 1–22, including drawings by J. Green, A. T. Hollick, N. H. Odhner, A. J. Peile, H. A. Pilsbry, F. A. Schilder, H. R. Simroth, E. A. Smith, G. B. Sowerby, E. R. Sykes, H. Watson and F. M. Woodward; a series of carved and etched shells.

Mr C. P. Castell: the Brander collection—a bicentenary exhibit.

Dr B. C. Clarke: the Partulae of Moorea—maps and specimens.

Mr T. E. Crowley: development of ultra-dextrality in the Ampullariidae.

Mr H. Doust: environments of deposition in the Miocene of southern Victoria.

Dr M. P. Kerney (on behalf of Mr A. W. Stelfox): the inheritance of scalariformity in *Helix aspersa* Müller.

Mr N. J. Morris: a link between the Monoplacophora and the bivalves.

Mr and Mrs P. E. Negus: types of coiling in fossil cephalopods; fossil gastropods, including an undescribed species of *Angaria*.

Mr C. P. Nuttall: ultra-fluorescence in fossil shells.

Mr T. Pain: molluscs from Lake Tanganyika.

Mr R. P. Scase: world-wide Volutidae (to illustrate his lecture).

Mr A. C. Simpson (Ministry of Agriculture, Fisheries and Food): biology of commercially exploited molluscs.

Mr J. W. Stephenson (Rothamsted Experimental Station): photographs illustrating the biology of snail- and slug-killing flies of the Sciomyzidae.

Dr J. D. Taylor: molluscan communities associated with a coral reef.

Dr J. D. Taylor and Dr J. W. Kennedy: electronmicrographs of shell structure.

Mr W. R. White (Central Electricity Research Laboratories): mussel fouling in power stations.

Publications of the Conchological Society of Great Britain & Ireland and of the Malacological Society of London.

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* See *J. Conch.* 14 (10): 316–319, 2 figs. (1915).

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CONTENTS

PAGE
Officers and Council for 1968–69 299
EMILY H. VOKES—On the identity of *Murex trigonulus* of authors (Gastropoda: Muricidae) 300
FRANZ ALFRED SCHILDER & MARIA SCHILDER—Statistics of a population of *Erosaria spurca* (L.) (Gastropoda: Cypraeidae) . . . 305
E. ALISON KAY—The Saul Cowry Collection 309
JOHN BOWDEN & DAVID HEPPELL—Pulteney's 'Dorset Catalogues' with special reference to the Mollusca 321
A. W. STELFOX—On the inheritance of scalariformity in *Helix aspersa* 329
Obituaries: Thomas George William Fowler, 1880–1967; Richard Turner, 1947–67 333
Reviews 335
Accounts for 1967 340
Proceedings: Members Elected; Annual Reports for 1967–68 . . 344
Changes of Address 351
PLATES 13–15

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J. Conch. **26**: 300–304. (1968)

ON THE IDENTITY OF *MUREX TRIGONULUS* OF AUTHORS (GASTROPODA: MURICIDAE)

EMILY H. VOKES
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(*Read before the Society*, 15 *October* 1966)

Recently I received a letter from Dr A. C. VAN BRUGGEN of the Natal Museum, Pietermaritzburg, South Africa,* requesting my advice on a muricid gastropod which had been submitted to him for identification. This particular shell was remarkable in that it had been recovered from the stomach of a fish, locally known as a 'musselcracker', taken off Port Shepstone (south coast of Natal) in 30 fathoms by BARRY CLARKE of Durban, Natal. Dr VAN BRUGGEN writes: 'Two fishes of the family Sparidae are known as musselcrackers, viz *Sparodon durbanensis* (Castlenau) and *Cymatoceps nasutus* (Castlenau); both are local endemics (Cape of Good Hope to Natal) and both are known to swallow molluscs, although they are frequently crushed, or at least show teeth marks.' Such was not the case in this instance, for the shell was perfectly 'preserved' and was readily recognizable from photographs as *Pterynotus annandalei*, described by PRESTON (1910: 118) from the Bay of Bengal, off Gopalpore [i.e. Gopalpur], India, in 38 fathoms. The length of the shell is 80·5 mm, maximum diameter 34 mm. The colour, according to Dr VAN BRUGGEN, is a beautiful purplish pink with white nodules.

Dr VAN BRUGGEN's tentative identification of the species was *Murex trigonulus* Lamarck, and as such this shell has been cited for many years. There are, however, two different species thus named by LAMARCK and thus figured by various authors. One of the shells figured as '*Murex trigonulus* Lamarck' is a Caribbean shell subsequently named *Murex pulcher* A. Adams, 1853. This name is preoccupied by *Murex pulcher* J. Sowerby, 1813, and the species is correctly to be denominated as *Chicoreus* (*Siratus*) *consuelae* (Verrill, 1950). LAMARCK actually never called this shell *M. trigonulus*, and the identification is based by REEVE (1845) on a *presumed* error. In the *Tableau Encyclopédique et Méthodique*, LAMARCK (1816) figured two species, one of which (pl. 417, fig. 4) he named *M. trigonulus*, the other (pl. 417, fig. 1) he cited as *M. triqueter* Born. In truth fig. 4, '*M. trigonulus*', represents BORN's species and fig. 1 is probably *C. consuelae*. In 1822, LAMARCK corrected his error by placing *M. trigonulus* in the synonymy of *M. triqueter* and cited the 1816 figure of '*M. triqueter*' (i.e. *C. consuelae*) as a variety

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* Now of the Rijksmuseum van Natuurlijke Historie, Leiden.

'b' of that species. KIENER (1843), who is usually the best authority on LAMARCK's species, for some unknown reason followed the 1816 nomenclature of LAMARCK. He figured *M. triqueter* Born as '*M. trigonulus*' (pl. 25, fig. 2) and figured as '*M. triqueter*' an unmistakable specimen of *C. consuelae* (pl. 40, fig. 3). REEVE, in the *Conchologia Iconica* (1845, pl. 1), came to the conclusion that: 'The *Murices triqueter* and *trigonulus* are figured in the "Encyclopédie Méthodique" and in KIENER's "Icon. Coq. viv." one for the other, and *vice versa*'. REEVE then figured as '*M. trigonulus*' (pl. 22, fig. 87) a magnificent specimen of *C. consuelae.* To this specimen, however, he attributed the locality 'Red Sea' rather than the Caribbean.

The error in locality seems to have arisen with the confusion of two different species as the *M. trigonulus* of LAMARCK, for the second does come from the Red Sea. This other species sometimes called '*M. trigonulus*' was first figured by SOWERBY (1841) in the *Conchological Illustrations* (pl. 195, fig. 102) with the locality 'Persian Gulph' [sic]. This form is the one subsequently named *Pterynotus annandalei* by PRESTON and is probably the *M. trigonulus* of LAMARCK, 1822, not 1816. LAMARCK (1822: 167), having placed the '*M. trigonulus*' of 1816 in synonymy with *M. triqueter*, considered the name to be again available and named another *M. trigonulus.* Unfortunately he gave no locality nor references to any published figure, so the identity of this species is questionable. As the name is preoccupied we are saved the necessity of searching for an answer, but the indications are that it is the form later named *P. annandalei.* LAMARCK stated only that it was to be distinguished from *M. triqueter* by its 'bourrelets subanguleux'.

POIRIER (1883: 68) cited '*M. trigonulus* Lamarck, 1882' as being from the Red Sea and the Persian Gulf, placing in its synonymy the figures given by SOWERBY representing *Pterynotus annandalei.* Unfortunately he also included the KIENER figure of *C. consuelae* (pl. 40, fig. 3), and so all doubt is not removed. The '*M. trigonulus*' of REEVE he correctly attributed to '*M. pulcher*' and made the following statement (p. 69): 'Le *M. pulcher* A.Ad., confondu souvent avec le *M. trigonulus* Lk., en diffère par une spire moins allongée, par une ouverture plus ronde et surtout par une queue plus grêle et beaucoup plus longue.' DUNKER (1864) recognized the presence of two species and figured the Red Sea form as '*M. trigonulus* variety' (pl. 22, figs. 3, 4). TAPPARONE-CANEFRI (1875: 573), in his study of the molluscs of the Red Sea, accepted REEVE's error of locality and included '*M. trigonulus*' (as figured by REEVE) with two varieties: 'major', as figured by SOWERBY (1841), and 'minor', as figured by DUNKER (1864).

In the *Thesaurus Conchyliorum*, SOWERBY (1879: pl. 391, fig. 119) identified *M. pulcher* (i.e. *C. consuelae*) as *M. trigonulus* Reeve not Lamarck and, as *M. trigonulus* (pl. 391, fig. 120), refigured the specimen shown in the *Conchological Illustrations*, nevertheless giving both a Red Sea locality. The most recent citation for this misunderstood species is the *M. trigonulus* of SMITH (1953: 4, pl. 8,

SMITHSONIAN INSTITUTION MAR 11 1969

figs. 8, 12) who copied the SOWERBY (1841) figures but gave the inexplicable locality 'Gambia, Africa'.

PRESTON described *Pterynotus annandalei* with no reference to *Murex trigonulus*, although both the SOWERBY and DUNKER illustrations are excellent. This species apparently is rare but widespread as it has been reported now from the northern Bay of Bengal and the Red Sea to Durban, South Africa. (SOWERBY's original citation of the Persian Gulf is open to question as he subsequently changed it to read 'Red Sea'.) In addition a closely related species, *Murex barclayi* Reeve, is known only from Mauritius, and another, as yet unnamed, similar species occurs off Japan. These three species, as well as BORN's '*Murex*' *triqueter*, are now referred to *Pterynotus* subgenus *Naquetia* Jousseaume, 1880 (type-species: *Murex triqueter* Born, 1778), characterized by the broad flange on the anterior portion of the varices. The species of *Naquetia* are all Indo-Pacific in distribution. The Caribbean species *C. consuelae* is assigned to *Chicoreus* subgenus *Siratus* because of the extended siphonal canal, and the lack of the anterior flange.

SYNONYMIES OF THE SPECIES DISCUSSED

Pterynotus (Naquetia) triqueter (Born, 1778)
(Pl. 13, figs. 3–4)

1778 *Murex triqueter* Born. *Index Mus. Caes. Vindob.*: 288.
1780 *Murex triqueter* Born. BORN, *Testacea Mus. Caes. Vindob.*: 291, pl. 11, figs. 1, 2.
1816 *Murex trigonulus* Lamarck. *Tableau Encyclopédique et Méthodique* **3**: pl. 417, figs. 4a, 4b.
1822 *Murex triqueter* Born. LAMARCK, *Hist. nat. Anim. sans Vert.* **7**: 166.
1843 *Murex trigonulus* Lamarck. KIENER, *Spec. gén. icon. Coq. viv.* **7**: 119, pl. 25, fig. 2.
1845 *Murex triqueter* Born. REEVE, *Conch. Icon.* **3** (*Murex*): pl. 1, fig. 4.
1879 *Murex triqueter* Born. SOWERBY, *Thes. Conch.* **4** (*Murex*): pl. 391, figs. 114, 115.
1953 *Murex (Pteronotus) triqueter* Born. SMITH, *Catalog Rock Shells*: 4, pl. 4, fig. 4.

Pterynotus (Naquetia) annandalei (Preston, 1910)
(Pl. 13, figs. 1–2)

1822 ?*Murex trigonulus* Lamarck. *Hist. nat. Anim. sans Vert.* **7**: 167 [non *Murex trigonulus* Lamarck, 1816].
1841 *Murex trigonulus* Lamarck. SOWERBY, *Conch. illustr.*: pl. 195, fig. 102.
1864 *Murex trigonulus* Lamarck *variety*. DUNKER, *Novit. Conch.*: pl. 22, figs. 3, 4.
1875 *Murex trigonulus* Lamarck *varieties a & b*. TAPPARONE-CANEFRI, *Muricidi Mar Rosso*: 9 [573].
1879 *Murex trigonulus* Lamarck. SOWERBY, *Thes. Conch.* **4** (*Murex*): pl. 391, fig. 120.
1883 *Murex trigonulus* Lamarck [partim]. POIRIER, *N. Archiv. Mus. Hist. nat.* (2) **5**: 68.
1910 *Pteronotus annandalei* Preston. *Rec. Indian Mus.* **5**: 118, fig. 3.
1953 *Murex (Pteronotus) trigonulus* Lamarck. SMITH, *Catalog Rock Shells*: 4, pl. 8, figs. 8, 12 (after SOWERBY, 1841, pl. 195, fig. 102).

Chicoreus (Siratus) consuelae (Verrill, 1950)
(Pl. 13, figs. 5–6)

1816 *Murex triqueter* Born. LAMARCK, *Tableau Encycl. Méth.* **3**: pl. 417, figs. 1a, 1b.
1822 *Murex triqueter* Born *variety b.* LAMARCK, *Hist. nat. Anim. sans Vert.* **7**: 166.
1843 *Murex triqueter* Born. KIENER, *Spec. gén. icon. Coq. viv.* **7**: 120, pl. 40, fig. 3.
1845 *Murex trigonulus* Lamarck. REEVE, *Conch. Icon.* **3** (*Murex*): pl. 22, fig. 87.
1853 *Murex pulcher* A. Adams. *Proc. zool. Soc. Lond.* (19): 270 [non *Murex pulcher* J. Sowerby, 1813, nec *M. pulcher* DeFrance, 1827].
1875 *Murex trigonulus* Lamarck [partim]. TAPPARONE-CANEFRI, *Muricidi Mar Rosso*: 9 [573].
1879 *Murex pulcher* Adams. SOWERBY, *Thes. Conch.* **4** (*Murex*): pl. 391, fig. 119.
1883 *Murex trigonulus* Lamarck [partim]. POIRIER, *N. Archiv. Mus. Hist. nat.* (2) **5**: 68.
1950 *Murex pulcher consuela* Verrill. *Minut. conch. Club Sth. Calif.* (101): 7, fig. 6.
1963 *Murex consuelae* Verrill *emend.* VOKES, *Tulane Stud. Geol.* **1** (3): 111.
1965 *Chicoreus* (*Siratus*) *consuelae* (Verrill). VOKES, *Tulane Stud. Geol.* **3** (4): 195.

ABSTRACT

Three different muricine species have been cited as '*Murex trigonulus* Lamarck' by authors. One of these species is *Murex triqueter* Born [= *Pterynotus* (*Naquetia*) *triqueter*] from the western Pacific Ocean; the second is *Murex pulcher* Adams [= *Chicoreus* (*Siratus*) *consuelae* (Verrill)] from the Caribbean Sea; and the third, probably the true *Murex trigonulus* of LAMARCK, 1822, non 1816, is identified as *Pterynotus* (*Naquetia*) *annandalei* (Preston), from the Indian Ocean.

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Explanation of Plate 13

Figures 1, 2. *Pterynotus* (*Naquetia*) *annandalei* (Preston). Off Natal, South Africa (from the stomach of a fish). Height 80.5 mm; maximum diameter 34 mm. Photographs by courtesy of Natal Museum.

Figures 3, 4. *Pterynotus* (*Naquetia*) *triqueter* (Born). Philippine Islands. Height 57.7 mm; maximum diameter 27.0 mm.

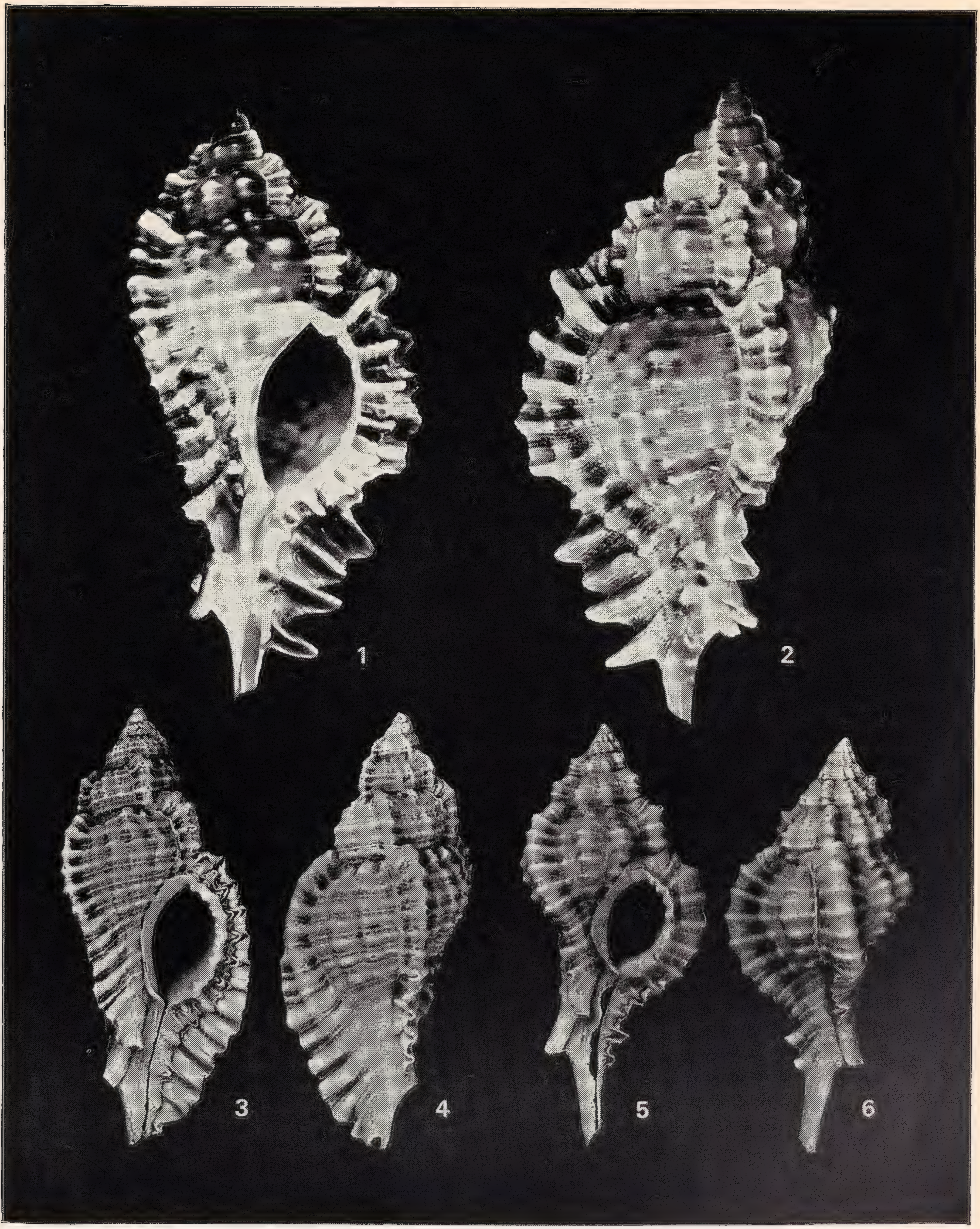
Figures 5, 6. *Chicoreus* (*Siratus*) *consuelae* (Verrill). Off Soufrière, St Lucia, British West Indies. Height 42.0 mm; maximum diameter 18.3 mm.

* * *

Editorial Note. *Pterynotus* and *Pteronotus*.

Swainson, 1833, described *Pterynotus* in the *Zoological Illustrations* (2) **3** (22): pl. 100, as a subgenus of *Murex*, and repeated this spelling on p. 109. On page and plate 122, however, Swainson changed the spelling to *Pteronotus*, presumably on etymological grounds. The latter spelling was adopted as correct by many later authors, including Preston in his description of *Pteronotus annandalei*. More recently it has been realized that *Pteronotus* is a junior homonym several times preoccupied, and the spelling *Pterynotus* has come into general usage. The synonymy of this genus has been discussed by Vokes, 1964 (Supraspecific groups in the subfamilies Muricinae and Tritonaliinae. *Malacologia* **2**: 1–41). The use of *Pterynotus* vice *Pteronotus* was also discussed by Clench & Pérez Farfante, 1945 (The genus *Murex* in the Western Atlantic. *Johnsonia* **1** (17)). Both Clench & Pérez Farfante and Vokes adopted the spelling *Pterynotus*: Clench & Pérez Farfante 'not only because it has page precedence, but because the later name, *Pteronotus*, is a homonym'; Vokes because it is 'the valid original spelling'. The validity of multiple spellings is not determined by page precedence, however, nor by the invalidity—on other grounds—of one of the names, but by the spelling adopted by the first reviser [ICZN Article 32(b)]. As 'an original spelling that . . . is one of the multiple spellings not adopted by a first reviser is an "incorrect original spelling" and . . . has no separate status in nomenclature, [it] . . . cannot be used as a replacement name' [Article 32(c)]. Thus if *Pteronotus* was adopted by the first reviser, *Pterynotus* would be unavailable. The expression 'first reviser' is not defined in the Code except in the case of synonyms [Article 24(a) (i)], but it is generally accepted that in the case of multiple original spellings the first subsequently adopted spelling is correct. By this definition Swainson acted as first reviser when, in 1835 (*Elements modern Conch.*: 19), he adopted the spelling *Pterynotus* (although in 1840 he reverted to *Pteronotus* (*Treatise Malac.*: 296).—David Heppell

PLATE 13



1, 2. *Pterynotus* (*Naquetia*) *annandalei* (Preston)
3, 4. *Pterynotus* (*Naquetia*) *triqueter* (Born)
5, 6. *Chicoreus* (*Siratus*) *consuelae* (Verrill)

J. Conch. **26**: 305–308. (1968)

STATISTICS OF A POPULATION OF *EROSARIA SPURCA* (L.) (GASTROPODA: CYPRAEIDAE)

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(*Read before the Society*, 15 *October* 1966)

Lt-Col. DAVID BAHRAL (Tel-Aviv, Israel) presented us with 998 adult shells of *Erosaria spurca* (L.) which were collected by himself, in 1955, on the beach of Herzlia, about 10 km north of Tel-Aviv. Though these shells are mostly rather worn with regard to colour, they represent excellent material for statistical analysis of size, shape and dentition; such a large population of this usually rather uncommon Mediterranean species has never been investigated before.

Table 1 shows the correlation between length (measured by calipers in μm, but here reduced to mm) and relative breadth (expressed as % of length). The encircled figure (27 specimens) indicates the 'median' of both variables (length = 24 mm, breadth = 64%). The vertical and horizontal lines crossing the table indicate the limits of 'usual variation', comprising about two-thirds of specimens approaching the median of each variable (length = 22–27 mm, breadth = 62–66%); these limits approach the limits of the standard deviation (SCHILDER & SCHILDER, 1966: 209).

The relation between the results obtained by our simplified methods and exact mathematical methods may be illustrated by the following data:

	LENGTH IN MM	RELATIVE BREADTH IN %
median class	24	64
mean ± mean error	24·46 ± 0·086	63·94 ± 0·083
'usual variation' classes	6	5
double standard deviation	5·44	5·26
'usual variation'	22–27	62–66
mean ± standard deviation	21·7–27·2	61·3–66·6

One will observe that the results of our rough methods agree fairly well with those of exact calculation, so that the simplifications of statistical method recommended by SCHILDER & SCHILDER (1966: 208–209) prove to be admissable. The area enclosed by the central rectangle in Table 1 theoretically contains $\frac{2}{3} \times \frac{2}{3} = \frac{4}{9}$, i.e. less than a half of the specimens; but a circle crossing the four corners of the rectangle will enclose about two-thirds of specimens—the 'usual variation' again.

Table I shows a slight negative correlation between the length and the relative breadth, as small shells are more frequently broad than are large shells. This correlation is mathematically significant, as the correlation coefficient $r = -0{\cdot}464 \pm 0{\cdot}025$.

Table I

length in mm

relative breadth (%)	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	SUM
72	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2
71	-	1	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	5
70	-	-	-	1	3	1	-	-	2	2	-	-	-	-	-	-	-	-	9
69	-	-	-	2	2	7	10	4	2	1	1	-	-	-	-	-	-	-	29
68	-	1	-	-	5	13	10	5	8	6	2	1	1	-	1	1	-	-	54
67	-	-	-	2	6	10	7	20	7	6	9	2	1	-	-	1	-	-	71
66	-	1	1	6	4	7	13	22	14	11	11	7	2	2	-	-	-	-	101
65	1	-	1	4	9	12	13	23	20	15	10	6	7	-	3	-	-	-	124
64	-	-	-	4	1	12	17	15	㉗	21	25	17	8	3	3	2	-	-	155
63	-	-	-	-	6	8	14	16	20	16	31	14	10	7	5	2	-	-	149
62	-	-	-	-	1	2	9	15	18	17	25	16	16	8	3	2	-	-	132
61	-	-	-	-	1	-	2	7	10	16	16	6	10	4	3	2	1	-	78
60	-	-	-	-	1	3	1	8	7	5	6	3	3	2	5	1	-	1	46
59	-	-	-	-	-	1	2	1	1	4	2	5	5	2	2	2	-	-	27
58	-	-	-	-	-	-	-	-	2	1	-	1	2	2	1	-	1	-	10
57	-	-	-	-	-	-	-	-	-	-	1	3	1	-	-	-	-	-	5
56	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
SUM	1	3	2	20	40	79	99	136	138	121	139	81	67	30	26	13	2	1	998

The very tiresome calculation of the correlation coefficient may be simplified by another rough method used by the writers when estimating the general tendency of correlation: if we designate the sum of the specimens contained in each of the four corner areas of Table I by

a = lower left corner
b = upper right corner
c = upper left corner
d = lower right corner

we can calculate a 'simplified correlation coefficient' by the formula

$$r^* = (a + b - c - d) \div (a + b + c + d)$$

The results can vary only between -1 and $+1$, and 0 indicates absence of any correlation, as indeed it does in the exact calculation of the correlation coefficient. In the present case:

$$r^* = (6 + 5 - 59 - 51) \div (6 + 5 + 59 + 51) = -99/121 = -0{\cdot}82$$

That is an exaggerated figure which nevertheless confirms the presence and the sign of a correlation between length and relative breadth in our population.

Table 2 shows the correlation between the closeness of the labial teeth and that of the columellar teeth. The closeness of teeth, i.e. the number of teeth in relation to the length of the shell, has been classified according to the tables published by Schilder, 1958. In two shells among the 998 the inner lip was damaged, so that the columellar teeth could not be counted; therefore the total shown in Table 2 is 996 instead of 998.

Table 2

		labial teeth										
		k	l	m	n	o	p	q	r	s	t	SUM
columellar teeth	r	-	-	-	-	-	-	-	1	-	-	1
	q	-	1	-	-	-	2	-	-	-	-	3
	p	-	-	-	-	1	2	2	-	1	-	6
	o	-	1	4	4	8	7	3	-	-	-	27
	n	1	4	8	26	26	28	10	13	3	-	119
	m	3	8	18	55	46	41	22	3	-	-	196
	l	-	17	41	87	68	51	16	7	-	1	288
	k	2	12	59	81	47	22	9	4	-	-	236
	i	-	7	22	41	16	13	1	3	-	-	103
	h	-	2	6	2	3	2	1	-	-	-	16
	g	-	-	-	1	-	-	-	-	-	-	1
	SUM	6	52	158	297	215	168	64	31	4	1	996

The following data may be calculated:

	LABIAL TEETH	COLUMELLAR TEETH
median	n	l
‘usual variation’	m–p	k–m
extreme variation	k–t	g–r

Thus the absolute number of teeth, viz the ‘usual variation’, and (in parentheses) the median, is in shells of:

	LABIAL TEETH	COLUMELLAR TEETH
20 mm	17 (18) 20	13 (14) 15
25 mm	18 (19) 21	14 (15) 16
30 mm	19 (20) 22	14 (15) 16

There is a slight positive correlation between the closeness of labial and columellar teeth, as our formula is

$$r^* = (9 + 33 - 7 - 5) \div (9 + 33 + 7 + 5) = +30/54 = +0{\cdot}56$$

Therefore shells with relatively numerous labial teeth rarely have extremely few columellar teeth, and vice versa.

Lt-Col. Bahral sent us these 998 *Erosaria spurca* in four parcels, taken at random from his large stores. If we call these series A, B, C, D, with 300, 399, 165, and 134 shells respectively, the median in length is practically identical: 24, 25, 24, and 24 mm respectively in the four parcels. The medians of smaller series, however, are far more different: when we measured the shells we took series of twenty specimens at random from the whole samples of B, C, and D, and calculated the median of each series separately. In this way we obtained medians of from 22 to 26 mm (which is almost the 'usual variation' of all specimens), viz:

median	22	23	24	25	26	mm
in	1	6	11	13	3	sets of 20 shells

Therefore such small series of twenty shells cannot be considered as showing the true medium size of the whole population, even when the specimens have been selected at random: they cannot be regarded as truly representative.

There is, however, a real difference in size between the 998 *E. spurca* from Herzlia and the 154 *E. spurca* from Tel-Aviv discussed by Schilder & Schilder, 1965. The latter were collected on the 3–4 km long beach of Tel-Aviv itself, by Mr Aryeh Hadar in 1954–61. Though there is only a short distance of a few miles between Tel-Aviv and Herzlia, the difference in length (in mm) of the shells of *E. spurca* is mathematically significant:

	MEAN	DIFFERENCE
Herzlia (Bahral)	24·46 ± 0·086	2·38 ± 0·252
Tel-Aviv (Hadar)	26·84 ± 0·314	

The parameter $t = 2{\cdot}38 \div 0{\cdot}252 = 9{\cdot}4$, far exceeding the value 3 required for a probability of identity of less than 0·27%. Therefore *Erosaria spurca* from Herzlia is distinctly smaller than that from a similar beach at Tel-Aviv only a few kilometres away.

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J. Conch. **26**: 309–320. (1968)

THE SAUL COWRY COLLECTION

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(*Read before the Society*, 21 *January* 1967)

JANE SAUL's cowry collection has been famous for more than a century. Well known for rarities such as *Cypraea broderipii*, *C. guttata*, *C. nivosa* and *C. venusta*, the collection also contains the types of six other species and more than half of the specimens figured in the monographs of *Cypraea* published by REEVE in the *Conchologia Iconica* (REEVE, 1845–46) and by SOWERBY in the *Thesaurus Conchyliorum* (SOWERBY, 1870). Despite its fame, the SAUL cowry collection has not previously been discussed in detail; the purpose of this paper is, therefore, to describe the rarities and types contained in the SAUL collection, which now forms a part of the zoological collections in the Zoological Museum, Cambridge University. An annotated list of figured specimens is also provided.

I am greatly indebted to Dr ANNA M. BIDDER, Zoology Department, Cambridge University, for searching out some of the primary source material, for allowing me access to the SAUL collection, and for her encouragement and helpful criticism.

HISTORICAL

JANE SAUL (1807–1895) was a Londoner who spent much of her life amassing a natural history 'cabinet' in her home at 33 Bow Street. Except for GASKOIN's (1843) note that Miss SAUL was 'an amiable and liberal collector', we know little of Miss SAUL herself. Her collection was considered 'one of the finest series ever gathered together during the last century' (DEAN, 1936), and included not only cowries but also exceptionally fine specimens of *Conus*, *Murex* and *Strombus*. From various labels which now accompany some of the specimens I have inferred that the collection was built primarily by purchase from dealers such as C. H. WRIGHT and ROBERT DAMON, and by exchange with Sir DAVID BARCLAY and W. R. CROUCH. The only contemporary account of the shells is that of HUGH FULTON, well-known dealer and collector, who valued the collection for probate; FULTON described the shells as 'arranged on cotton-wool and *unnamed*; there are no trays or divisions of any kind' (Letter 298, FULTON to S. F. HARMER, Balfour Library).

JANE SAUL died on 2 September 1895. Her will, dated 6 December 1894, left, 'To the University of Cambridge my collection of shells, . . . and cabinets containing the same, . . . my *Conchologia Iconica* and other conchological books'. The bequest was made as a result of a suggestion by GEORGE BARROW and her old friend and executor MAXWELL T. MASTERS (Letters 295 and 296, Balfour

Library). The collection reached Cambridge in December 1895, when Sir Sydney F. Harmer was Director of the Museum.

Despite Fulton's statement that the collection was unnamed, there is with it a small notebook, the entries in mid-nineteenth-century feminine handwriting, which contains a list of 148 species. Each species in the list is also numbered according to Reeve (1845–46). Several specimens in the collection bear labels with the notebook numbers in the same feminine handwriting. The notebook and the labels I have inferred to be those of Miss Saul.

Since their arrival in Cambridge, the cowries have been studied by both S. F. Harmer and H. C. Fulton. Pencilled labels bearing Harmer's initials now accompany several specimens; these were probably written soon after the arrival of the collection in Cambridge. Fulton cleaned, identified, and arranged the collection in 1923, his work supported by a donation by Vernon W. MacAndrew.

Methods

In the following account detailed descriptions of the rarities and types are given, and these are followed by an annotated list of the species figured from the collection by Reeve (1845–46) and Sowerby (1870). The annotations include the Saul catalogue number and mention of labels associated with the specimens. While Fulton's treatment of the collection has been used as the framework for the list, specific names have been brought up to date, although only two generic names, *Cypraea* and *Trivia*, are utilized. No attempt has been made to include subspecies since there are no collection data available. The species are treated alphabetically.

Rarities and Types

Cypraea barclayi Reeve, 1857

The holotype was figured by Sowerby (1870: pl. 14, figs. 91, 92). Its dimensions are: length 25 mm, diameter 16 mm, height 14 mm. The shell is solid, ovate, and the extremities are produced. The dorsum is pale ivory, minutely peppered with yellow-brown; the anterior extremity is tinted with pink; the sides, base and teeth are ivory. The base is flat; the labial teeth are strong and produced across the base, while the columellar teeth are weaker and only the anterior teeth cross the base; there are 19 labial teeth and 19 columellar teeth. The fossula has three projections.

The specimen was dredged off the island of Diego Garcia [Chagos Archipelago] by Sir David Barclay who '. . . allowed it to pass from his hands, thinking that more would reward his research, but, to his disappointment, another specimen has not turned up' (Melvill, 1888). Two other specimens have been recorded (Sowerby, 1903: 230; Barnard, 1963: 46): of these, one is lost and the other is figured by Schilder, 1967. The latter specimen is in the South African Museum.

Cypraea broderipii Sowerby, 1832

There are two specimens in the SAUL collection, the larger of which was figured by SOWERBY (1870: pl. 14, figs. 87, 88). The dimensions are: (i) length 74 mm, diameter 49 mm, height 41 mm, labial teeth 31, columellar teeth 39; (ii) length 70 mm, diameter 46 mm, height 39 mm, labial teeth 27, columellar teeth 28. Only the larger specimen is in good condition, representing an almost perfect example of the species; the smaller specimen is marred by stains and blotches on the dorsum.

MELVILL (1888) recorded six specimens of *C. broderipii*: two in Miss SAUL's collection, one each in the British Museum (Natural History) and in the now dispersed collection of HUGH OWEN, and two others for which the locations were not known. DANCE (1960) reported a further specimen from the stomach of a musselcracker, *Cymatoceps nasutus* (Castlenau), off Durban. WEAVER (1961) figured a specimen in the collection of Mrs HELEN BOSWELL, also thought to be from a musselcracker and, more recently, HARMON (1967) described and illustrated the 'eighth known' specimen of *C. broderipii*, taken from the stomach of a musselcracker at a depth of 100 fm south-east of Durban. In fact this specimen appears to be only the seventh whose present whereabouts is known. HARMON's 'seventh' is a specimen in the American Museum of Natural History, formerly in the collection of Mrs S. L. WILLIAMS of Chicago (DANCE, 1966: 219).

Cypraea castanea Higgins, 1868

Holotype: length 44 mm, diameter 26·5 mm, height 23 mm. The shell is pyriform and light. The dorsum is mottled with contiguous chestnut-brown marks on a grey background; the sides and base are pink-fawn; the teeth are dark brown. The margin is produced at the anterior extremity where it is obsoletely pitted. The labial teeth are produced across the base; the columellar teeth are in the form of a series of wrinkles, those on the anterior third more distinct than those on the posterior two-thirds of the base; there are 24 labial teeth and 8 columellar teeth. There is no fossula.

The history of the specimen is indicated by a note written by W. R. CROUCH attached to a specimen of *C. castanea* in the British Museum (Natural History): 'This was in J. SAUL's Collection till she got HIGGINS' type-specimen (beautifully marked with chestnut and about the same size) from HUGH OWEN's cabinet'. The note is dated 13 September 1881.

SHAW (1909) placed *C. castanea* in the synonymy of *C. similis* Gray and, as both these names were preoccupied, renamed the species *C. fuscorubra*.

Cypraea guttata Gmelin, 1791

Of the sixteen specimens of *C. guttata* discussed by WOODWARD (1963), two are in the SAUL collection. The dimensions of the SAUL specimens are: (i) length 62 mm, diameter 39·5 mm, height 31 mm, labial teeth 23, columellar teeth 19; (ii) length 52 mm, diameter 29·5 mm, height 24 mm, labial teeth 23, columellar teeth 19. Both shells are in excellent condition, glossy and richly coloured. The only label with the specimens is that of S. F. HARMER: '*C. guttata.* S.F.H.'

Since WOODWARD's (1963) summary, four more specimens have been reported: one from Malaita in the Solomon Islands (ABBOTT, 1964; RIET, 1965) and three from New Guinea (HAYES, 1965).

Cypraea modesta Sowerby, 1870

Holotype: length 20·5 mm, diameter 13 mm, height 9 mm, labial teeth 17, columellar teeth 13. Figured by SOWERBY, 1870 (pl. 31, figs. 333, 334), as *C. menkeana* var. *modesta*. The shell is short and stubby with the extremities upturned. The dorsum is ivory-white peppered with red-brown and with a large blotch on the left and shadows in the centre. The base is white, peppered with red-brown. The teeth are strong, produced across both the labial and columellar bases.

A blue label accompanying the specimens states: '*C. modesta* Owen—the largest specimen is the type figured by SOWERBY', and another note, in an unidentified hand, states the specimen was that figured in SOWERBY's *Thesaurus Conchyliorum*. *C. menkeana* and *C. modesta* are now considered synonyms of *C. owenii* Sowerby, 1832.

Cypraea nivosa Broderip, 1827

There are four specimens in the SAUL collection with the following dimensions: (i) length 60 mm, diameter 37 mm, height 32 mm, labial teeth 27, columellar teeth 33; (ii) length 59 mm, diameter 38 mm, height 29 mm, labial teeth 28, columellar teeth 27; (iii) length 52 mm, diameter 31 mm, height 27 mm, labial teeth 25, columellar teeth 28; (iv) length 41 mm, diameter 26 mm, height 22 mm, labial teeth 24, columellar teeth 25. The specimens are all in excellent condition, with the dorsum light brown, freckled with white ocellae, the sides and base pale, the sides striated with fine threads. The largest specimen was figured by SOWERBY (1870: pl. 14, figs. 89, 90).

Cypraea saulae Gaskoin, 1843

Holotype: length 20 mm, diameter 10 mm, height 9 mm, labial teeth 15, columellar teeth 16. The shell is elongate-oval, and light; it is marginate on the right only, the extremities are produced and it is umbilicate. The dorsum is grey-brown with a central dark brown blotch and approximately twelve scattered, smaller spots. The margins are spotted with four larger dark brown spots on the right, three on the left; the base is cream and lightly spotted towards the edges. The interstices of the teeth are orange-yellow. The teeth are coarse, not produced across the base.

In naming this species after Miss SAUL, GASKOIN (1843) noted that HUGH CUMING had discovered the shell in the Philippines and requested that it be named after JANE SAUL. The holotype was figured by SOWERBY (1870: pl. 14, figs. 85, 86).

Cypraea trizonata Sowerby, 1870

Holotype: length 13·5 mm, diameter 7 mm, height 6 mm, labial teeth 25, columellar teeth 28. The shell is elongate, marginate, and light. The dorsum is white, banded with three light brown zones and faintly peppered with darker brown. The margin is white, light spotted as is the base. The base is convex, the teeth very fine and white; the teeth barely extend on to the base over the labial lip and do not extend on to the columellar lip. A juvenile specimen in the SAUL collection is 10·5 mm in length, 6 mm in diameter, and 5 mm in height.

A label in the holotype bears the number '149'. The holotype was figured by SOWERBY (1870: pl. 32, figs. 361, 362). *C. trizonata* is now considered a subspecies of *C. punctata* L., 1771, with a distribution in Eastern Polynesia from the Cook Islands to the Tuamotus and Marquesas (SCHILDER & SCHILDER, 1938).

Cypraea valentia Perry, 1811 [= *C. princeps* Gray, 1824]

The single specimen in the SAUL collection has the following dimensions: length 93 mm, diameter 65 mm, height 56 mm, labial teeth 35, columellar teeth 40. The shell is large, ovate, and light. The dorsum is brown-yellow, tinged with rose towards the base and there are brown splotches on either side of a centre line; the margins are spotted with brown. The extremities are creamy, marked with brown ridges; the base is also cream but tinted with rosy brown and spotted; the columellar teeth are brown. The labial teeth are short; the columellar teeth are fine and not produced across the base. The specimen is marred by a crack on the left side near the umbilical region.

The five specimens noted by MELVILL (1888) are still the only recorded examples of this species.* Of the other four, two are in the British Museum (Natural History), one is in the Zoological Museum, Amsterdam, and the fifth, which was originally in the collection of JAMES COX of Sydney, Australia, is in the DAUTZENBERG collection at the Institut royal des Sciences naturelles de Belgique, Brussels (SCHILDER & SCHILDER, 1952).

Cypraea venusta Sowerby, 1847

Holotype: length 70 mm, diameter 40 mm, height 37·5 mm, labial teeth 24, columellar teeth 9. Except for a pin-hole just above the umbilicus and another on the posterior portion of the columellar lip, the shell is in good condition. The dorsum is creamy, flesh-coloured, sparsely blotched with orange-brown, and the sides, base, teeth, and interstices are ivory. The base is flat; the labial teeth are barely produced on to the base; of the nine visible columellar teeth the anterior six are fairly strong and the posterior three weak. The umbilical area is grooved.

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* A sixth specimen of *C. valentia*, from the New Guinea area, is in the collection of PHILLIP W. CLOVER of Chula Vista, California (DANCE, 1968)—Editor.

ANNOTATED LIST OF SPECIES

albuginosa Gray, 1825
Saul Cat. No. 47. 6 specimens. *Conch. Icon.* pl. 18, fig. 94: figured specimen not identified. Label: Saul No. 47.

annettae Dall, 1909
14 specimens as *C. sowerbyi*. Figured *Conch. Icon.* pl. 10, fig. 40 [as *C. sowerbyi*]: length 47 mm, diameter 27 mm, height 22 mm. Label: Saul No. 92.

antillarum Schilder, 1922 [*Trivia*]
1 specimen as *C. lathyrus*. Figured *Conch. Icon.* pl. 26, fig. 150 [as *C. pulla*]: length 7 mm, diameter 5 mm, height 5 mm.

aperta Swainson, 1822 [*Trivia*]
5 specimens as *C. oniscus*. Figured *Conch. Icon.* pl. 20, figs. 111a, b [as *C. oniscus*]: length 23 mm, diameter 18 mm, height 15 mm.

arabica L., 1758
Saul Cat. No. 2. 46 specimens. Figured *Conch. Icon.* pl. 1, fig. 2: length 82 mm, diameter 51·5 mm, height 41·5 mm.

argus L., 1758
Saul Cat. No. 25. 20 specimens. Figured *Conch. Icon.* pl. 3, fig. 8: length 93 mm, diameter 50 mm, height 39 mm. Labels: Saul No. 25; 'Amboyna'.

australis Lamarck, 1822 [*Trivia*]
Saul Cat. No. 114. See *T. merces* Iredale.

barclayi Reeve, 1857
Holotype. See previous discussion.

bicallosa Gray, 1831
Saul Cat. No. 52. See *C. surinamensis* Perry.

bicolor Gaskoin, 1849
Saul Cat. No. 104. See *C. piperita* Gray.

bregeriana Crosse, 1868
Saul Cat. No. 74. See *C. walkeri* Sowerby.

brevidentata Sowerby, 1870
See *C. stolida* L.

brevissima Sowerby, 1870 [*Trivia*]
6 specimens. *Thes. Conch.* pl. 37, figs. 523, 524: figured specimen not identified.

broderipii Sowerby, 1832
Saul Cat. No. 19. 2 specimens. See previous discussion.

capensis Gray, 1828
6 specimens. Figured *Conch. Icon.* pl. 17, fig. 86: length 33 mm, diameter 20 mm, height 16 mm. Label: Saul No. 108.

caputserpentis L., 1758
50+ specimens. Juvenile figured *Thes. Conch.* pl. 37, fig. 539: figured specimen not identified.

carneola L., 1758
Saul Cat. No. 12. 22 specimens. Figured *Conch. Icon.* pl. 6, fig. 19: length 85 mm, diameter 48 mm, height 42·5 mm.

castanea Higgins, 1868
Holotype. See previous discussion.

caurica L., 1758
Saul Cat. No. 82. 54 specimens. Figured *Conch. Icon.* pl. 11, fig. 46: length 47 mm, diameter 29 mm, height 20 mm. Label: Saul No. 82.

citrina Gray, 1825
Saul Cat. No. 50. 3 specimens (1 juvenile). Figured *Conch. Icon.* pl. 16, figs, 78a, b: length 21 mm, diameter 15 mm, height 12 mm. The posterior marginal pits are distinctive and identify the figured specimen but it has either faded with time or the artist over-emphasized the dorsal blotches.

clandestina L., 1767
Saul Cat. No. 98. 21 specimens. *Conch. Icon.* 'pl. XIX, fig. 106b': although indicated in the text, there is no figure 106b on plate 19. Saul label: '*C. clandestina*'.

cribraria L., 1758
Saul Cat. No. 78. 25 specimens. Figured *Conch. Icon.* pl. 16, fig. 81: length 29 mm, diameter 16 mm, height 13 mm. Label: Saul No. 78.

depauperata Sowerby, 1832 [*Trivia*]
Saul Cat. No. 132. 3 specimens. Figured *Conch. Icon.* pl. 23, fig. 133: length 13 mm, diameter 11 mm, height 8 mm. Label: Saul No. 132.

edentula Gray, 1825
Saul Cat. No. 106. 18 specimens. Figured *Conch. Icon.* pl. 17, figs. 85a, b: length 24 mm, diameter 14·5 mm, height 13 mm.

erosa L., 1758
Saul Cat. No. 55. 50+ specimens. Figured *Conch. Icon.* pl. 11, fig. 43: length 49 mm, diameter 31 mm, height 22·5 mm.

exanthema L., 1767
Saul Cat. No. 20. See *C. zebra* L.

exusta Sowerby, 1832
Saul Cat. No. 24. 3 specimens. Figured *Conch. Icon.* pl. 2, fig. 4: length 69 mm, diameter 38·5, height 34 mm.

fimbriata Gmelin, 1791
Saul Cat. No. 102. 20+ specimens. Figured *Conch. Icon.* pl. 18, fig. 92: figured specimen not identified.

friendii Gray, 1831
6 specimens as *C. scottii*, several juvenile. Figured *Conch. Icon.* pl. 4, fig. 10 [as *C. scottii*]: length 85 mm, diameter 45 mm, height 38 mm.

fuscodentata Gray, 1825
Saul Cat. No. 107. 1 specimen. *Conch. Icon.* pl. 17, fig. 88: ventral view only; specimen in collection not positively identified as that figured.

fuscorubra Shaw, 1909
See previous discussion under *C. castanea* Higgins.

granulata Pease, 1862
10 specimens as *C. madagascariensis*. Figured *Conch. Icon.* pl. 15, figs. 75a, b [as *C. madagascariensis*]: length 32 mm, diameter 22 mm, height 14 mm.

guttata Gmelin, 1791
2 specimens. See previous discussion.

helvola L., 1758
64 specimens. Figured *Thes. Conch.* pl. 25, fig. 216: length 30 mm, diameter 25 mm, height 14 mm. Label: Saul No. 51.

hesitata Iredale, 1916
6 specimens. Figured *Thes. Conch.* pl. 7, figs. 43, 44 [as *C. umbilicata*]: length 92 mm, diameter 49·5 mm, height 42·5 mm. One specimen with label: 'Bryce Wright. *Cypraea umbilicata.* Australia'.

hirundo L., 1758
Saul Cat. No. 66. 21 specimens as *C. neglecta*, 15 specimens as *C. hirundo*. *Conch. Icon.* pl. 19, fig. 100 [as *C. neglecta*]: figured specimen not identified.

lathyrus Kiener, 1843 [*Trivia*]
Saul Cat. No. 135. See *T. antillarum* Schilder.

lutea Gmelin, 1791
7 specimens. Figured *Conch. Icon.* pl. 20, fig. 110c: figured specimen not identified.

madagascariensis Gmelin, 1791
Saul Cat. No. 45. See *C. granulata* Pease.

mappa L., 1758
Saul Cat. No. 1. 69 specimens. Figured *Conch. Icon.* pl. 6, fig. 18: length 89·5 mm, diameter 45·5 mm, height 40 mm; *Thes. Conch.* pl. 5, figs. 24–28: fig. 26: length 87 mm, diameter 55 mm, height 52 mm; fig. 28: length 80 mm, diameter 55 mm, height 40 mm. Other figured specimens not identified.

maugeriae Sowerby, 1832 [*Trivia*]
Saul Cat. No. 140. 1 specimen. Figured *Conch. Icon.* pl. 21, fig. 119; *Thes. Conch.* pl. 35, figs. 450, 451.

mauritiana L., 1758
Saul Cat. No. 5. 22 specimens. Figured *Conch. Icon.* pl. 1, fig. 1a (juvenile): length 83 mm, diameter 60 mm, height 55 mm.

menkeana Deshayes, 1863
See previous discussion under *C. modesta* Sowerby.

merces Iredale, 1924 [*Trivia*]
9 specimens. Figured *Conch. Icon.* pl. 24, fig. 138 [as *C. australis*]: length 15 mm, diameter 10 mm, height 8 mm.

modesta Sowerby, 1870
Holotype. See previous discussion.

moneta L., 1758
SAUL Cat. No. 62. 37 specimens. *Conch. Icon.* pl. 15, fig. 74: figured specimen not identified.

mus L., 1758
15 specimens. Figured *Conch. Icon.* pl. 7, figs. 24a, b: length 58 mm, diameter 48·5 mm, height 30 mm. Label: SAUL No. 34.

neglecta Sowerby, 1832
SAUL Cat. No. 68. See *C. hirundo* L.

nigropunctata Gray, 1828
SAUL Cat. No. 93. 6 specimens. Figured *Conch. Icon.* pl. 13, fig. 59: length 37 mm, diameter 22 mm, height 22 mm.

nivosa Broderip, 1827
SAUL Cat. No. 18. 4 specimens. See previous discussion.

obvelata Lamarck, 1810
SAUL Cat. No. 61. 9 specimens. *Conch. Icon.* pl. 15, fig. 69 [as *C. obvallata*]: figured specimen not identified.

oniscus Lamarck, 1810 [*Trivia*]
SAUL Cat. No. 111. See *T. aperta* Swainson.

onyx L., 1758
SAUL Cat. No. 88. 36 specimens. Figured *Conch. Icon.* pl. 10, fig. 39a (var. *adusta*): length 48 mm, diameter 28 mm, height 25 mm; fig. 39b (var. *carnicolor*): length 48 mm, diameter 38·5 mm, height 24 mm. Label: '*onyx*—DAMON'.

owenii Sowerby, 1832
5 specimens, 1 is the holotype of *C. modesta* (see previous discussion).

pallida Gray, 1824
SAUL Cat. No. 94. 1 specimen. *Conch. Icon.* pl. 13, fig. 54: specimen not identified as that figured.

pantherina Lightfoot, 1786
SAUL Cat. No. 4. 37 specimens. Figured *Conch. Icon.* pl. 3, fig. 7: length 89 mm, diameter 57 mm, height 50 mm.

piperita Gray, 1825
15 specimens as *C. bicolor*. *Conch. Icon.* pl. 17, fig. 87 [as *C. piperata*]: figured specimen not identified.

producta Gaskoin, 1836 [*Trivia*]
2 specimens. Figured *Thes. Conch.* pl. 36, figs. 495, 496. Figured specimen not identified.

pulchella Swainson, 1823
SAUL Cat. No. 71. 6 specimens. Figured *Conch. Icon.* pl. 11, figs. 42a, b and *Thes. Conch.* pl. 19, fig. 148: length 41 mm, diameter 23 mm, height 20 mm; *Thes. Conch.* pl. 19, fig. 149: specimen not identified; fig. 150: length 34 mm, diameter 21 mm, height 18 mm; the lateral blotch is reversed in the figure.

pulchra Gray, 1824
SAUL Cat. No. 27. 4 specimens. Figured *Conch. Icon.* pl. 9, figs. 34a, b: length 58 mm, diameter 34 mm, height 30 mm.

pulla Reeve, 1846 [*Trivia*]
See *T. antillarum* Schilder.

punctata L., 1771
SAUL Cat. No. 70. 35 specimens (including the holotype of *C. trizonata*—see previous discussion). Figured *Conch. Icon.* pl. 19, figs. 101, 101a: length 22 mm, diameter 12 mm, height 9 mm.

pyriformis Gray, 1824
SAUL Cat. No. 72. 5 specimens. *Thes. Conch.* pl. 19, figs. 145–147: 'Miss SAUL's beautiful specimens'. Figured specimens not found.

pyrum Gmelin, 1791
SAUL Cat. No. 89. 17 specimens. *Conch. Icon.* pl. 8, fig. 26: figured specimen not identified. Label: SAUL No. 68 on 3 specimens.

quadrimaculata Gray, 1824
SAUL Cat. No. 64. 7 specimens. *Conch. Icon.* pl. 19, fig. 107: figured specimen not identified. Label: SAUL No. 64.

saulae Gaskoin, 1843
Holotype. See previous discussion.

scottii Broderip, 1832
SAUL Cat. No. 33. See *C. friendii* Gray.

similis Gray, 1831
See previous discussion under *C. castanea* Higgins.

sowerbyi Kiener, 1845
See *C. annettae* Dall.

spadicea Swainson, 1823
SAUL Cat. No. 87. 3 specimens. Figured *Conch. Icon.* pl. 7, fig. 21: length 56 mm, diameter 32 mm, height 26·5 mm. Label: '*spadicea*' in one specimen.

spurca L., 1758
15 specimens. Figured *Conch. Icon.* pl. 14, fig. 68: length 29 mm, diameter 17 mm, height 14 mm. Label: SAUL No. 53.

staphylaea L., 1758
SAUL Cat. No. 43. 47 specimens. *Conch. Icon.* pl. 16, figs. 82a, b: figured specimens not identified.

stolida L., 1758
SAUL Cat. No. 67. 15 specimens as *C. stolida.* Figured *Conch. Icon.* pl. 14, figs. 67a, b: length 30 mm, diameter 17 mm, height 15 mm. 3 specimens with SAUL label: *stolida* var. *brevidentata* Sowerby.

subviridis Reeve, 1835
SAUL Cat. No. 73. 10 specimens. Figured *Conch. Icon.* pl. 12, figs. 48a, b: length 32 mm, diameter 20 mm, height 16 mm.

sulcidentata Gray, 1824
SAUL Cat. No. 8. 6 specimens (1 juvenile). Figured *Conch. Icon.* pl. 8, figs. 29a, b: length 45 mm, diameter 34 mm, height 28 mm.

surinamensis Perry, 1811
3 specimens as *C. bicallosa.* Figured *Conch. Icon.* pl. 16, fig. 79 [as *C. bicallosa*]: length 34 mm, diameter 20 mm, height 16 mm.

tabescens Dillwyn, 1817
SAUL Cat. No. 76. See *C. teres* Gmelin.

talpa L., 1758
SAUL Cat. No. 23. 11 specimens. Figured *Conch. Icon.* pl. 2, fig. 5: length 93 mm, diameter 46 mm, height 38 mm. Label: '*Cypraea talpa.* C. H. WRIGHT'.

teres Gmelin, 1791
23 specimens as *C. tabescens. Conch. Icon.* pl. 14, fig. 66b [as *C. tabescens*]: figured specimen not identified.

tessellata Swainson, 1822
SAUL Cat. No. 37. 4 specimens (1 juvenile). Figured *Conch. Icon.* pl. 12, fig. 53 and *Thes. Conch.* pl. 17, figs. 99, 100: length 30 mm, diameter 24 mm, height 19 mm. Label: SAUL No. 37.

testudinaria L., 1758
SAUL Cat. No. 22. 10 specimens. Figured *Conch. Icon.* pl. 3, fig. 9a: figured specimen not identified.

trizonata Sowerby, 1870
Holotype. See previous discussion and under *C. punctata.*

turdus Lamarck, 1810
SAUL Cat. No. 58. 17 specimens. 1 specimen with FULTON label: '*Thes. Conch.*, pl. XXVIII, fig. 284': length 45 mm, diameter 26 mm, height 21 mm. Figure shows more dense colouring than in the specimen.

umbilicata Sowerby, 1825
See *C. hesitata* Iredale.

valentia Perry, 1811
1 specimen. See previous discussion.

venusta Sowerby, 1847
Holotype. See previous discussion.

vesicularis Gaskoin, 1836 [*Trivia*]
2 specimens. Figured *Thes. Conch.* pl. 33, figs. 412, 413: length 14 mm, diameter 9 mm, height 7·5 mm. Smooth area on dorsum identifies shell.

vitellus L., 1758
SAUL Cat. No. 11. Many specimens. Figured *Conch. Icon.* pl. 5, fig. 14: length 77 mm, diameter 53 mm, height 44 mm.

walkeri Sowerby, 1832

4 specimens as *C. bregeriana.* Figured *Conch. Icon.* pl. 12, figs. 50a, b: length 26 mm, diameter 16 mm, height 13 mm. Label: SAUL No. 74.

xanthodon Sowerby, 1832

SAUL Cat. No. 136 as *C. 'zanthodon'*. 3 specimens. Figured *Conch. Icon.* pl. 13, figs. 55a, b: length 29·5 mm, diameter 18 mm, height 14·5 mm. Label: SAUL No. 135.

zebra L., 1758

7 specimens as *C. exanthema.* Figured *Conch. Icon.* pl. 5, fig. 16 [as *C. exanthema*]: length 106 mm, diameter 57·5 mm, height 45 mm.

zonaria Gmelin, 1791

13 specimens as *C. zonata.* Figured *Conch. Icon.* pl. 13, fig. 58 [as *C. zonata*]: length 31 mm, diameter 20 mm, height 16 mm [figure has more zigzags than in specimen but is otherwise a good match]. Label: 'Gubba'.

zonata Chemnitz, 1788 [non-binominal]

SAUL Cat. No. 91. See *C. zonaria.*

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PULTENEY'S 'DORSET CATALOGUES'

WITH SPECIAL REFERENCE TO THE MOLLUSCA

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A number of new specific names of Mollusca occur in the first edition of the work entitled *Catalogues of the Birds, Shells, and some of the more rare Plants, of Dorsetshire*, compiled by RICHARD PULTENEY and dated 1799. Many of these names may be relegated to the synonymy of earlier names, but a number are the oldest available for the species concerned. Because the '*Catalogues*' were considered, e.g. by WINCKWORTH, not to have been validly published (Cox, 1940: 121, footnote 2), these names have commonly been attributed to the authors who first subsequently published them.* The present authors have re-examined this supposition with regard to the criteria for valid publication prescribed in the *International Code of Zoological Nomenclature*, 1961 [see footnote], and conclude that these criteria are satisfied; accordingly the names must be considered available as of PULTENEY, 1799.

The history of the *Catalogues* may be summarized as follows. When the Revd JOHN HUTCHINS died, in 1773, he had completed, but not published, a monumental work entitled *The History and Antiquities of the County of Dorset.* Among those who were aware of his labours was WILLIAM CUMING, M.D., F.S.A., a physician of Dorchester. He enlisted subscriptions from friends and the leading gentry of the county and undertook the publication of the work, which duly appeared in two folio volumes in 1774. It contained no contributions on natural history. Some time afterwards a demand arose for a second edition, and the printer and publisher of this proposed edition was to be the antiquary JOHN NICHOLS of London. WILLIAM CUMING again assisted in promoting it, and he now enlisted the aid of his friend RICHARD PULTENEY, M.D., F.R.S., F.R.S.E., a physician at Blandford Forum, Dorset, whom he persuaded to contribute a section on the natural history of the county. PULTENEY's manuscript, embodying his observations over a period of thirty-four years, was completed in 1799 and sent to JOHN NICHOLS who set it up and printed off a number of copies which were duly returned. They were the only printed copies of his work that PULTENEY saw, for he died in 1801.*

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* Cox (1940) has written: 'It does not, however, appear that this advance issue should rank as a publication, although it is included in SHERBORN'S *Index Animalium* [1902] and KENNARD and WOODWARD [1926] have stated . . . that it is "always admitted as a valid work". . . . Compare T. IREDALE, *Proc. malac. Soc.* **11**: 333 (1915). R. WINCKWORTH (in litt.) remarks, "The names take status from their quotation by DONOVAN 1802, 1803, and 1804, MONTAGU 1803, and in one case WOOD 1802 (*Mactra hians*), and are so treated by me in *The British Marine Mollusca*, 1932; e.g. no. 172, *Thracia pubescens* (Montagu) *ex Mya pubescens* Pulteney, 1799".' Prior to the 1961 *International Code of Zoological Nomenclature* there were no rules laid down determining the criteria of valid publication for purposes of zoological nomenclature. This is now covered by ICZN Article 8, the relevant sections of which may be quoted here: 'To be regarded as published within the meaning of this Code, a work when first issued must (1) be reproduced in ink on paper by some method that assures numerous identical copies; (2) be issued for the purpose of scientific, public, permanent record; (3) be obtainable by purchase or free distribution; (4) not be reproduced or distributed by a forbidden method (Article 9).' The 1799 edition of PULTENEY'S *Catalogues* satisfies the above conditions.

These copies each consisted of 92 folio pages of which pp. 22–54 were devoted to 'A Catalogue of Shells found on the Dorsetshire coast: or, animals of the Molluscous Tribe of Vermes, inhabiting a calcareous shell'. The title-page bears the date 1799 and the words 'printed . . . for the use of the compiler and his friends'. It is evident that they were not mere proofs but fully corrected final copies issued as pre-prints or separates in advance of the main work. Four copies of this separate have been examined by us,† and others also are no doubt still in existence.

PULTENEY's *Catalogues* were intended to form part of the concluding (third) volume of the second edition of HUTCHINS's *History*, the first two volumes of which appeared in 1796 and 1803. This third volume, however, was still unpublished when, on the night of 8 February 1808, 'the Printing-office and extensive Warehouses of *John Nichols and Son* . . . with an immense stock of Books, the accumulation of nearly 50 years, were overwhelmed in one calamitous ruin, by a most aweful fire . . .' (NICHOLS, 1808). Unlike the first edition of HUTCHINS's *History* (1774), which had rapidly exhausted six re-printings, the second edition had been a slow seller, only about 112 copies having been taken, including a number given away as presents (NICHOLS, 1811). The remainder of the stock, together with the almost completed volume 3, perished in the fire. As it was obviously not an economical proposition to print only 112 copies of such a work to satisfy the requirements of those who had bought the earlier volumes, the future of the venture looked gloomy. It was decided, however, to open a subscription list and this proposal was submitted by NICHOLS 'to the consideration of the Publick, and especially to the Nobility and Gentlemen of the County more immediately interested in the completion of the Work, without whose powerful support it cannot with any degree of prudence be undertaken' (Nichols, 1811).* When 'the names of about 90 Encouragers had been received, the Work was resumed with spirit' in 1812 (Anon, 1813). The intended concluding volume was split into two smaller volumes which eventually appeared in 1813 and 1815. Nichols enlisted the aid of the Revd Thomas Rackett to edit Pulteney's *Catalogues* and these, incorporating Rackett's additions, were included in volume 3 as a separately-paged appendix consisting of iv + 110 folio pages (of which pp. 22–61 were devoted to shells), illustrated with a portrait of Pulteney, 23 plates of Recent shells (quarto plates, two to a page) and one folio plate of fossils.† In the third edition of Hutchins's *History*, Pulteney's contribution was replaced by lists compiled by J. C. Mansel-Pleydell.

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* PULTENEY's manuscripts were bequeathed to WILLIAM GEORGE MATON, M.D., F.R.S., a physician of Salisbury, Wilts.; his valuable library was sold by Leigh & Sotheby in 1802; his herbarium and collections of shells and minerals were bequeathed to the Linnean Society of London, to be either kept as a separate collection or to be sold to provide funds for an annual medal. The herbarium later passed to the British Museum. The collection of shells was included in the material sold on behalf of the Society at Stevens's Auction Rooms in 1863 (GAGE, 1938: 125; COX, 1940: 124, from an advertisement in the *Athenaeum* **for 1863** (1): 762). The purchaser is unrecorded. A priced catalogue of this sale is in the Linnean Society's Library (DANCE, 1967: 7, footnote). The medal was not established.

† One in the library of the British Museum; one in the library of the Botany Department of the British Museum (Natural History); two in the library of the Linnean Society of London. A copy of the second edition (1813) of PULTENEY's *Catalogues*, now in the library of the Linnean Society of London, contains an inscription by THOMAS RACKETT stating that the 'first impression' was printed in 1801. This must be an error since the lists of donations in an early minute book of the Linnean Society show that PULTENEY gave the Society a copy some time before 2 July 1799 (Miss SANDRA RAPHAEL, *in litt.*).

The new molluscan names which occur in the 1799 edition of Pulteney's *Catalogues* are listed seriatim below. Names which in our opinion are not synonyms of earlier names are printed in ***bold italics*** and, in view of the rarity of this work, it has been thought desirable to reproduce the original descriptions of these in an Appendix. Plate references are to the 1813 edition of the *Catalogues*, not to the *Triton Britannicus*. Cited localities indicate the geographical range of the exotic species. The generic names in brackets indicate the current placement of each species. The species of *Balanus* and *Lepas*, included by Pulteney among the 'multivalves', and the species of *Serpula* and *Sabella*, included by Pulteney among the 'univalves', are not considered in this paper.

* * *

Pholas hians p. 26 (non Gmelin, 1791) = *Pholas dactylus* L., 1758 [*Pholas*]. Pl. 3, fig. 2 as *P. dactylus*.

Pholas nanus p. 27 = *Pholas striatus* L., 1758 [*Martesia*]. Pl. 1, fig. 7 as *P. striata*. Western Atlantic, Eastern Pacific and Indo-Pacific.

Pholas faba p. 27 = *Mya dubia* Pennant, 1777 [*Gastrochaena*]. Pl. 1, fig. 11 as *Mya dubia*.

Mya ovalis p. 27 (non *Mya ovalis* Lightfoot, 1786, nec *Unio ovalis* Philipsson, 1788) = *Mya pictorum* L., 1758 [*Unio*]. Pl. 12, fig. 4 as *Mya pictorum*. The misinterpretation of *Mya pictorum* L. by early British conchologists has been discussed by Kennard & Woodward (1924: 134 *et seq.*). *Unio ovalis* Philipsson was tentatively synonymized with *U. pictorum* (L.) by Kennard &

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* Nichols indicated the following 'Conditions. 1. The Number to be printed, and whether on large or small paper, must be regulated by the number of Subscribers. 2. The total Subscription for the Two Volumes on the small paper to be twelve guineas. 3. The Subscription for the large paper to be sixteen guineas. 4. As soon as One Hundred Copies are subscribed for, the Work shall be immediately put to press.'

† No plates were published with the 1799 edition of the *Catalogues*, but Pulteney refers throughout to an MS. collection of plates under the title '*Triton Britannicus*'. This was never issued separately except in proof form, but turns up in the 1813 edition as the 23 plates of Recent shells. These plates are a rearrangement of those in da Costa's *Historia Naturalis Testaceorum Britanniae*, 1778, with the addition of six others. For further information on the *Triton Britannicus* see Reynell (1916), Woodward (1917) and Cox (1940: 122–123). The plate of fossil shells is also discussed by Cox (op. cit.).

WOODWARD (1926: 336). *Mya ovalis* Lightfoot occurs on p. 134 of the *Portland Catalogue* [the new names from which were formerly attributed to SOLANDER until DANCE (1962) showed that their publication should be credited to LIGHTFOOT]. IREDALE (1916) listed the available names dating from the *Portland Catalogue*, including *Mya ovalis*, but later writers seem to have overlooked this name. It was based on 'LISTER t. 146, f. 1', which represented a specimen from the Danube. According to REHDER (1967: 23) it is the Central European subspecies otherwise known as *Unio crassus cytherea* Küster. As this is the nominate form of *U. ovalis* (Lightfoot), the West European subspecies, occurring fossil in England, becomes *Unio ovalis crassus* Philipsson.

Mya pubescens pp. 27–28 [*Thracia*]. Pl. 4, fig. 6 as *M. declivis*.

Mya praetenuis p. 28 [*Cochlodesma*]. Pl. 4, fig. 7.

Solen marginatus p. 28 [*Solen*]. Pl. 4, fig. 8 as *S. vagina*.

Solen antiquatus p. 28. Although this name is attributed by SHERBORN (1902) to PULTENEY, 1799, it was validly published by LIGHTFOOT thirteen years earlier in the *Portland Catalogue* (IREDALE, 1916; REHDER, 1967). The name is, however, predated by *Solen chamasolen* da Costa, 1778 [*Solecurtus*].

Solen fragilis p. 28 = *Solen divisus* Spengler, 1794 [*Tagelus*]. Pl. 4, fig. 5. Caribbean.

Tellina variabilis p. 29 = *Tellina depressa* Pennant, 1777 [*Psammobia*]. Pl. 5, fig. 1 as *Solen vespertinus*.

Tellina laeta p. 29 = *Tellina punicea* Born, 1778 [*Tellina*]. Pl. 7, fig. 5 as *T. punicea*. Caribbean.

Tellina squalida p. 29 [*Tellina*]. Pl. 5, fig. 2 as *T. depressa*.

Tellina solidula p. 29 = *Tellina balthica* L., 1758 [*Macoma*]. Pl. 8, fig. 4.

Tellina polita p. 29 (non Poli, 1795, nec Spengler, 1798) = *Tellina tenuis* da Costa, 1778 [*Tellina*]. Pl. 5, fig. 3 as *Tellina tenuis*.

Tellina fausta p. 29 [*Tellina*]. Pl. 5, fig. 5. Caribbean.

Tellina discors p. 54 = *Tellina fabula* Gmelin, 1791 [*Tellina*]. Pl. 12, figs. 3, 3a as *T. fabula*.

Tellina proficua pp. 29–30 [*Semele*]. Pl. 5, fig. 4 as *T. reticulata*. Caribbean. *T. proficua* was synonymized by most early writers with *T. reticulata* L., 1767, but this synonymy is almost certainly incorrect, as pointed out by DODGE (1952: 49–50).

Tellina rigida p. 30 = *Tellina crassa* Pennant, 1777 [*Tellina*]. Pl. 7, fig. 4 as *T. crassa*.

Tellina undata p. 30 = *Tellina rotundata* Montagu, 1803 [*Diplodonta*], non *Venus undata* Pennant, 1777. Pl. 5, fig. 8 as *T. rotundata*.

Cardium corneum p. 31 = *Tellina cornea* L., 1758 [*Sphaerium*]. Pl. 7, fig. 2.

Cardium amnicum p. 31 = *Cyclas rivicola* Lamarck, 1818 [*Sphaerium*], non *Tellina amnica* Müller, 1774.

Mactra dealbata p. 31 = *Mactra fragilis* Gmelin, 1791 [*Mactra*]. Pl. 7, fig. 7. Caribbean.

Mactra tellinoides p. 31 = *Mactra fragilis* Gmelin, 1791 [*Mactra*]. Caribbean.

Mactra compressa pp. 31–32 = *Trigonella plana* da Costa, 1778 [*Scrobicularia*]. Pl. 7, fig. 1 as *M. listeri*.

Mactra hians p. 32 = *Chama magna* da Costa, 1778 [*Lutraria*]. Pl. 2, fig. 4.

Donax plebeia p. 32 = *Mactra cornea* Poli, 1795 [*Donacilla*]. Pl. 5, fig. 13. Mediterranean.

Venus paphia p. 33 (non L., 1758) = *Pectunculus fasciatus* da Costa, 1778 [*Clausinella*]. Pl. 7, fig. 3 as *Venus fasciata*.

Venus lincta p. 34 = *Venus lupinus* L., 1758 [*Dosinia*]. Pl. 1, fig. 13 as *V. exoleta* var.

Venus virginea p. 34 (non L., 1767) = *Venus rhomboides* Pennant, 1777 [*Paphia*]. Pl. 13, fig. 1.

Venus nebulosa p. 34 (non Gmelin, 1791) = *Venus aurea* Gmelin, 1791 [*Paphia*]. Pl. 13, fig. 3 as *V. aurea*.

Arca crinita pp. 34–35 = *Arca lactea* L., 1758 [*Arcopsis*]. Pl. 11, fig. 5 as *Arca lactea*.

Ostrea lineata p. 36 = *Pecten lineatus* da Costa, 1778 = *Ostrea opercularis* L., 1758 [*Aequipecten*]. Pl. 10, fig. 8.

Ostrea distorta p. 36 = *Pecten distortus* da Costa, 1778 [*Chlamys*]. Pl. 10, figs. 3, 6 as *Ostrea sinuosa.*

Ostrea striata p. 36 = *Ostreum striatum* da Costa, 1778 = *Anomia patelliformis* L., 1761 [*Pododesmus*]. Pl. 11, fig. 4 as *Anomia undulata.*

Pinna muricata p. 39 (non L., 1758) = *Pinna carnea* Gmelin, 1791 [*Pinna*]. Caribbean.

Pinna pectinata p. 39 (non L., 1758) = *Pinna fragilis* Pennant, 1777 [*Atrina*]. Pl. 3, fig. 3.

Cypraea arctica pp. 39–40 [*Trivia*]. Pl. 22, fig. 6 as *Cypraea pediculus.*

Buccinum porcatum p. 41 (non da Costa, 1778, nec Gmelin, 1791, nec Röding, 1798) = *Buccinum testiculus* L., 1758 [*Cypraecassis*]. Caribbean.

Buccinum hepaticum p. 41 [*Nassarius*]. Indo-Pacific. The shell figured under this name on Pl. 15, fig. 13 is not this species.

Buccinum ambiguum p. 42 (non Solander, 1766) = *Nassa alba* Say, 1826 [*Nassarius*]. Pl. 18, fig. 19*. Caribbean. JEFFREYS (1867: 353) considered this species to be synonymous with *Buccinum incrassatum* Ström, 1768, and not the *Nassa ambigua* auctt. which JEFFREYS (tom. cit.: 355) refers to as 'a common West-Indian shell'. PULTENEY himself cites *Buccinum minutum* Pennant, 1777, as a synonym, which *is* generally agreed to be a synonym of STRÖM's species. On the basis of the original description, however, the name applies to the Caribbean rather than to the European species, and this contention is supported by the figure in RACKETT's edition cited above and by the figure in MONTAGU (1803: pl. 9, fig. 7) who first received the species from PULTENEY and, moreover, clearly distinguished it from STRÖM's species which he described under the name *Buccinum macula.*

Strombus costatus p. 42 (non Gmelin, 1791) = *Strombiformis costatus* da Costa, 1778 [*Cerithidea*]. Pl. 14, fig. 14. Caribbean.

Murex reticulatus p. 43 = *Strombiformis reticulatus* da Costa, 1778 [*Bittium*]. Pl. 14, fig. 13.

Trochus crassus p. 44 = *Turbo lineatus* da Costa, 1778 [*Monodonta*]. Pl. 17, figs. 3, 7.

Trochus fragilis p. 44 (non Gmelin, 1791) = *Trochus papillosus* da Costa, 1778 [*Calliostoma*]. Pl. 16, figs. 5, 6 as *T. papillosus.*

Trochus exiguus p. 44 = *Trochus exasperatus* Pennant, 1777 [*Jujubinus*]. Pl. 22, fig. 4.

Turbo neritoides pp. 44–45 (non L., 1758) = *Nerita littoralis* L., 1758 [*Littorina*]. Pl. 16, figs. 13–16 and pl. 20, figs. 2, 3 as *N. littoralis.*

Turbo fontinalis p. 45 = *Nerita piscinalis* Müller, 1774 [*Valvata*]. Pl. 18, figs. 3, 4.

Turbo costatus p. 45 (non Gmelin, 1791, nec von Salis, 1793, nec Adams, 1797) = *Turbo parvus* da Costa, 1778 [*Rissoa*]. Pl. 19, fig. 4 as *T. parvus.*

Turbo tridens p. 46 (non *Turbo tridens* Gmelin, 1791 = *Helix tridens* Müller, 1774) = *Helix goodalli* Férussac, 1821 [*Azeca*]. Pl. 19, fig. 12.

Helix umbilicatus p. 47 = *Helix contorta* L., 1758 [*Bathyomphalus*]. Pl. 20, fig. 11 as *H. contorta.*

Helix lucida p. 47. Pl. 19, fig. 22 as *H. nitens.* The identity of this species is uncertain as the name appears to cover more than one species. The original description is reproduced in the Appendix hereunder. PULTENEY himself cited *Helix pellucidus* Pennant, 1777 (non *Helix pellucida* Müller, 1774) as a synonym, and both PENNANT and PULTENEY referred to the same figure in GUALTIERI. PENNANT's species has been identified by PFEIFFER (1847: 60; 1878: 63) and TRYON (1886: 138) as *Helix crystallina* Müller, 1774 [*Vitrea*], but whether this is so or not, PULTENEY's description refers not to a *Vitrea* but to a larger zonitid. Two species have been claimed as the *Helix lucida* of PULTENEY (non Draparnaud, 1801, nec Draparnaud, 1805): *Helix nitidula* Draparnaud, 1805 [*Aegopinella*] (TAYLOR, 1908: 73; KENNARD & WOODWARD, 1926: 178); *Helix cellaria* Müller, 1774 [*Oxychilus*] (TRYON, 1886: 155). Of these, PULTENEY's description seems to fit *Oxychilus cellarius* best.

Helix virgata p. 47 = *Cochlea virgata* da Costa, 1778 [*Cernuella*]. Pl. 20, fig. 7.

Helix rufescens p. 47 (non Pennant, 1777, nec Gmelin, 1791) = *Cochlea rufescens* da Costa, 1778 = *Helix striolata* C. Pfeiffer, 1828 [*Trichia*]. Pl. 20, fig. 6.

Helix compactilis p. 48. This is probably a variety of *Helix nemoralis* L., 1758 [*Cepaea*], but the PENNANT figure cited, said by PULTENEY to be 'very exact', is of a juvenile *Viviparus.*

Helix limosa p. 48 (non L., 1758) = *Helix putris* L., 1758 [*Succinea*]. Pl. 18, fig. 19 as *Helix succinea.*

Helix laevigata p. 49 (non L., 1767, nec *Helix laevigatum* Pennant, 1777) = *Bulla velutina* Müller, 1776 [*Velutina*]. Pl. 18, fig. 9.

Helix stagnorum p. 49 (non Gmelin, 1791) = *Helix lubrica* Müller, 1774 [*Cochlicopa*]. Pl. 21, fig. 18 as *Helix lubrica.*

Helix ulvae p. 49 = *Turbo ulvae* Pennant, 1777 [*Hydrobia*]. Pl. 18, fig. 12 as *Turbo ulvae.*

Helix detrita p. 49. Pl. 19, fig. 26. The identity of this species is uncertain. PULTENEY himself stated: 'I have affixed MÜLLER's name to this shell; but I am by no means certain of being right.' It was said to be a freshwater shell. The description may apply to *Helix detrita* Müller, 1774, a southern European species of *Zebrina.* FORBES & HANLEY (1852: 92–93), however, considered that: 'a great part of the description . . . was derived from the common West Indian' *Bulimus guadalupensis* Bruguière, 1789 [*Bulimulus*]. Both these species are terrestrial. The figure in the second edition is inadequate for identification.

Helix bifasciata p. 49 = *Helix acuta* Müller, 1774 [*Cochlicella*]. Pl. 18, figs. 8, 10.

Helix polita p. 49 (non Müller, 1774, nec *Turbo politus* L., 1758) = *Strombiformis albus* da Costa, 1778 (non *Turbo albus* Pennant, 1777) [*Balcis*]. Pl. 19, fig. 15.

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We should like to thank Miss SANDRA RAPHAEL, librarian of the Linnean Society of London, for assistance and information relating to the copies of PULTENEY's Catalogues in the Society's library, and for providing microfilm and xerographic material; Mr ROBERT JEFFERS, for a number of details concerning the editions of the *Dorset Catalogues*; and Mr PETER DANCE and Mr A. RODGER WATERSTON, for their criticisms of the manuscript.

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APPENDIX

Original descriptions of valid names published by Pulteney, 1799.

[overleaf]

A CATALOGUE OF SHELLS FOUND ON THE DORSETSHIRE COAST.

MYA

p.27 M. PUBESCENS. Teſta ovata, ſubpellucida, fragili, antice ſubtruncata, compreſſo-planiuſcula; regione tota ſubumbonali pubeſcente-ſcabro: cardinis dente ſemiovali. PUBESCENT MYA. Figured in *Trit. Brit.* t. 4. f. 6. *Shell*, perfectly white, thin, and brittle. The largeſt I have ſeen, two inches and a half long, three inches and three quarters wide. Slightly ſtriated in a direction concentrical with the umbo. *Hinge*, with a large thick ſemi-oval tooth in each valve, ſtanding parallel with the edge of the ſhell, not at right angles, as in the *Mya truncata*. This tooth is furniſhed with a ſmall denticle, or point in the middle. Firſt noticed by the late ducheſs-dowager of Portland. Dredged up at Waymouth. Whether
p.28 it is the *M. declivis* of *Pennant* I cannot ſay, as his deſcription is too ſhort.

M. PRÆTENUIS. Teſta ovata ſubpellucida fragili, regione ſubumbonali pubeſcente; cardinis dente ovali patulo. Chama *prætenuis* cardine cochleato porrectiore. *Petiv. Gaz.* t. 94. 4. or ſmall *Engliſh White Spoonhinge.* It may be called, WHITE SPOONHINGE MYA. *Trit. Brit.* t. 4. f. 7.

It is entirely a ſnowy-white; the largeſt I have ſeen is three quarters of an inch long, and one inch and three-eighths wide. In ſhape it reſembles the preceding. Whether it be the young of the ſame ſhell I dare not aſſert. The hinge is very different; the tooth being an entirely oval proceſs, reſembling in ſhape the bowl of a ſpoon. *Pennant's* figure of his *Tellina fragilis*, which, however, cannot be the *Tellina fragilis* of *Linnæus*, reſembles our ſhell, but a tellen hinge totally precludes the idea of its being the ſame. *Petiver* received his ſhell from Poole, where I have found it on the ſands, in the harbour, and on the North ſhore, near Brownſea Iſle, and once a few valves on the ſhore between Waymouth and Portland.

Had Dr. Solander lived to finiſh his ſyſtematic deſcription of the Portland cabinet, it was his intention to have conſtituted a new genus, in which theſe two ſhells, together with the *Solen bullatus*, and other ſhells in that cabinet, were to have been included.

SOLEN

S. MARGINATUS. *Soland. Muſ. Portland. Trit. Brit.* t. 4. f. 8. *Pen.* t. 46. f. 21. MARGINATED SOLEN. *Shell*, ſtraight, linear. each valve with one tooth; the hinge end with a large tranſverſe furrow, and a broad margin. Colour of the ſhell, cinereous, or yellowiſh-brown. Probably a variety only of the European *S. vagina*, from which it ſeems to differ only in the width of the margin, at the extremity. I ſuſpect it to be the ſhell deſcribed by Mr. *Pennant* as the *S. vagina.* Very rare. Dredged up at Waymouth.

TELLINA

p.29 T. SQUALIDA. *Soland. Muſ. Portland.* Depreſſa. *L. G.* 3238. *Gualt.* 88. L. M. SMOOTH FLAT TELLEN. *Trit. Brit.* t. 6. f. 2. An oblong, thin, flat ſhell, extended anteriorly into a beak, ſomewhat like the *T. roſtrata*, but quite ſmooth, unlike that ſhell, though minutely ſtriated in the tranſverſe direction. It is about three quarters of an inch long, an an inch and a half broad, of a pale yellow colour, and without ſpots, or ſtripes, ſometimes inclining to a carnation-colour. On the North ſhore at Poole: at Waymouth, ſparingly.

T. FAUSTA. *Soland. Muſ. Port. Liſt.* 266. 102. *Trit. Brit.* t. 6. f. 5. Teſta ſuborbiculata ſubcompreſſa, lactea tranſverſaliter rugoſo-ſtriata. *Shell*, milky white; but in many ſpecimens tinged on the inſide with bright yellow. Found on the Britiſh ſhore: one inch and three-eighths long, by one inch and ſix-eighths wide; exotic ſpecimens three inches long, by three inches and a half wide. One of the primary teeth in each hinge is bifid. The lateral tooth of the right valve very remote, and remarkably ſtrong. Nearly allied to the *T. Remies*, but diſtinguiſhed from it by Dr. *Solander.* Dredged up at Waymouth, under the inſpection of the late ducheſs dowager of Portland. Small ones, an inch wide, found on the ſhore.

T. PROFICUA. *Muſ. Port.* Teſta lenticulari, ſtriis, tranſverſis memoranaceis elevatis; longitudinalibus, minutiſſimis; cardinis foſſula magna lineari. *Petiv. Gaz.* t. 93. f. 18. CANCELLATED LENTICULAR TELLEN. *Trit. Brit.* t. 6. f. 4. *Shell*, nearly lentiform, an inch and three-eighths long, by an inch and a half wide; ſlightly convex, when full grown, thick, and ſtrong. White on the outſide, about the umbones, and within yellow. *Umbones*, ſmall, and acute.

Hinge, remarkably diſtinguiſhed by a long deep p.30
furrow, running from the apices, by the ſide of the lateral teeth, under the umbonal region. Outſide of the ſhell thick ſet with raiſed membranaceous ſtriæ; the interſtices moſt minutely ſtriated, in the longitudinal direction. Theſe ſtriæ are ſcarcely viſible in the recent ſhell without a magnifier. The larger ſhells are, not unfrequently, tinged on the inſide with a bright yellow, and punctuated.

On the ſands at the North ſhore, Poole, and at Waymouth.

CYPRAEA

C. ARCTICA. *Solander, Muſ. Portland. Liſt. Ang.* p.39
t. 3. 17. *Ejuſd. Conch.* 707. 57. *Gualt.* t. 14.

O. P. *Borlace*, t. 28. 13. *Pen.* 70. 80. p.40
ARCTIC COWRIE. *Shell*, differs from the foregoing in being ſmaller; in wanting the longitudinal furrow on the back; and in being without ſpots. I have found it at Poole, and at Waymouth.

Probably only a variety of the former, in a depauperated ſtate.

BUCCINUM

B. HEPATICUM. *Soland. Muſ. Portland. Liſt. Conch.* p.41
975. 50. SMALL KNOBBED BUCCINUM. *Shell*, one inch long, five-eighths of an inch wide; of a dull browniſh colour. *Volutions*, ribbed, and longitudinally waved, and ending upwards in knobs. *Spire*, ſharp, prominent, conſiſting of five or ſix volutions. Outer lip, ſtriated within. Inner lip, diſtinguiſhed by one fold, or tooth, in the upper part. Nearly allied to the *B. arcularia.* Found in Purbeck; and dredged up at Waymouth; but rarely.

HELIX

H. LUCIDA. M. P. pellucida. *Pen.* 134. *Gualt.* p.47
t. 2. G. Teſta pellucida, umbilicata, depreſſa, læviſſima. PELLUCID SNAIL. *Shell*, about three-eighths of an inch long, exactly reſembling the foregoing in figure, but quite ſmooth and gloſſy, and wholly without ſtriæ, marks, or bands.

Found on plants in the river Stour.

J. Conch. **26**: 329–332. (1968)

ON THE INHERITANCE OF SCALARIFORMITY IN *HELIX ASPERSA*

A. W. STELFOX
21 Tullybrannigan Road, Newcastle, Co. Down

(*Read before the Society*, 21 *January* 1967)

Having been brought up to believe that such variations as sinistrality and scalariformity in the shells of Mollusca were merely freaks of nature and, therefore, non-heritable, I long continued to hold to this belief, though as years passed I gradually began to doubt if it could be true, as there appeared to be evidence that such varieties were more often found in some localities than in others which had been as often collected in.

Hence, one evening in the spring of 1940 when I was clearing *Helix aspersa* Müller from my garden at Harold's Cross, Dublin, on finding two very conical specimens which possessed such similar marks of growth that I believed them to be sibs from one and the same batch of eggs, instead of putting my foot on them, with the rest, I decided to breed from them in the hope that by intensive inbreeding a breed with more and more conical shells might materialize and eventually, perhaps, a scalariform race be established. With this optimistic end in view the two specimens were placed in a compartment of one of my breeding boxes 8 × 6 × 4 inches deep, with about $1\frac{1}{2}$ inches of sand in the bottom and covered by a sheet of glass.

On 20 June 1940 the F_1 generation duly appeared and the two parents were removed and killed (Figs. 1, 2).

When the F_2 generation was nearly adult the experiment was split into three lines or branches in a box of three compartments, labelled left, mid, and right, respectively. In September 1949 the F_7 generation was so crowded in the original mid compartment that the surplus specimens were removed and put into the three compartments of a new box, referred to subsequently in my MS. notes as 'The Box of Three'. Generation after generation followed, the parents of which were always selected from those whose shells had the highest spire. Although the height of the spire did increase, the increase was somewhat disappointing and I began to wonder whether the opinion of some of my more candid friends—that I was wasting my time—would prove correct. I was, however, encouraged to carry on the experiment by the fact that many of the newborn snails at first gave the impression that their mature shell might be scalariform (Figs. 3, 4), though these specimens had the uncanny knack of correcting the spire during growth, so that the embryonic shell protruded somewhat from the apex of the spire, almost as if it had been stuck on crooked. This fact, as I say, encouraged me to continue the experiment and, amongst the F_5 generation in the right-hand line of descent, born on 8 August 1947, a single scalariform specimen occurred (Fig. 5). This I called 'The Corkscrew', and since then I have used this term to describe such scalariform shells. Strange to say, the sibs of this corkscrew in the right-hand line were on the whole less conical than the average in the F_5 of the left-hand line.

Following the occurrence of the first corkscrew in 1947, lean years followed during which many broods were hatched which appeared to be going to follow its lead, but with growth, as described above, the spire was always corrected and brought back to the normal conical shape of the breed and, though very conical, the adult shells were not scalariform and I once more began to doubt of ever breeding more than the odd freak corkscrew, which I presumed might occur in the best of families.

In June 1956 we moved from Dublin to Newcastle, Co. Down, to a smaller house, without a garage (at that time) and with half an acre of uncultivated ground to be turned into a garden by ourselves alone. The removers managed to hide the fact that they had left the old breeding boxes behind, and the only thing I was able to do in the emergency was to substitute six-inch diameter earthenware flower-pots, put some sand in these and place them in the little greenhouse, which in full sun became desperately hot and the reverse when frosty weather came. The result of course was that in these small pots the snails did not thrive, seldom mated, and if eggs were laid they often became too dry and did not hatch; but I was too busy in the garden to heed all this and it was a couple of years before I came to realize the truth of the old story that a watered earthenware pot makes a very fair 'fridge', and that my experiments would never prosper under such conditions. Nevertheless—during the following year in the late summer—four broods were born in which a percentage of the young were corkscrews. The first of these broods was bred in the left-hand compartment of the Box of Three (which snails were derived from the original mid line and the two parents belonged to the F_8 generation of that line). Now, if both parents had laid eggs, the young corkscrews could have all come from one of the batches and the non-corkscrews from the eggs laid by the other parent, and there is a possibility that this is the explanation of both forms occurring in the same brood, but my experiments were not carried out in a sufficiently scientific manner to prove this.

The second and third broods which yielded corkscrews were born in the original mid line, the parents belonging to the F_{10} generation. In this case I must now confess there were no less than six possible parents, which I had allowed to mature and mate at random while I was on holiday.

The fourth and last brood to produce corkscrews was born in late August or early September from two parents belonging to the F_6 generation of the original right-hand line. Although I have just referred the two parents to the F_6 generation, they were in reality the produce of a mating of the original corkscrew (born on 8 August 1947) with one of its own progeny (belonging to the true F_6 generation!), which at this time (1957) were of considerable age.

As in the first case, each of the parents of this fourth brood may have laid eggs and the corkscrews may all have come from those laid by one of them. This appearance of corkscrews in batches is reminiscent of the sinistral *Lymnaea peregra* bred by BOYCOTT and others in their famous experiments on the inheritance of sinistrality in *L. peregra* (DIVER *et al.*, 1925), where it was strongly suggested that the decision whether an individual would be dextral or sinistral was actually taken before the fertilization of the egg, but I have not enough evidence to suggest that this may have been the case with my corkscrew *Helix aspersa*, and must leave future experimentation to decide the matter.

The provision of more space in a garage, and wooden boxes to replace pots, which became available the following year came too late and I, personally, failed to breed from any of the corkscrews in the four broods born in 1957. Several kind friends showed an interest in my experiment and so I gave each a pair of young corkscrews to breed from, but never heard from them again. The most enthusiastic of these friends, a schoolmaster, to whom I entrusted a pair of my very best corkscrews, went to Australia a few months later but, like the others, did not return my corkscrews nor send me any information concerning his endeavour to breed from them. Soon after this I was, however, lucky enough to make the acquaintance of Mr G. W. PITCHFORD of Southwell, Notts. To him I gave two corkscrews from the F_{10} generation in the Box of Three (left), in August 1959. On 12 June 1960 he observed these in the act of mating and later that season he counted 'about seventeen young' in the box, but 'many soon died and two were accidentally killed'. Three of the dead young were selected at random and sent to me. All three are the most beautiful baby corkscrews, and Mr PITCHFORD holds to the opinion that the remainder were similar, but were not preserved.

One of the parent corkscrews died later that year and it is not known which laid the eggs. I would, however, suspect from my experience that the one which died may have become egg-bound through drought while Mr PITCHFORD was on holiday.

From PITCHFORD's second mating the following year, 1961, between the surviving corkscrew and a specimen of var. *unicolor* Moquin-Tandon, whose parents he had collected at Hazelbank, Aller, S. Devon, on 22 July 1958, I have now breeding three lines, one of which is a pure line of the recessive whitish-shelled variety known as var. *exalbida*, extracted from the F_2 generation. The shells of the F_3 generation of this *exalbida* strain are now, when three-quarters grown, very conical and, although perhaps foolishly, I opine that in the not-too-distant future we may have have an *exalbida* breed of corkscrews.

Owing to my advancing age I have passed on for breeding purposes specimens descended from the original mid line, including the only corkscrew bred by me since 1957, which was born in 1965, to Dr Lawrence Cook of Manchester University, as well as normally coloured and var. *exalbida* from the F_3 generation of Pitchford's second cross.

From the above facts some will, I think, agree with me that they provide fair proof that scalariformity in *Helix aspersa* may be regarded as an heritable character. Some, however, may prefer to await further evidence before deciding and it is to be hoped that Dr Cook and his school of young geneticists will be able to provide the absolute proof required during the next few years and, if this proof is eventually forthcoming, I hope I may claim that my twenty-six years' experiment has not been entirely 'a waste of time'.

Acknowledgment

I am most grateful to Dr Michael Kerney for the preparation of the accompanying plate.

Reference

Diver, C., Boycott, A. E. & Garstang, S., 1925. The inheritance of inverse symmetry in *Limnaea peregra*. *J. Genet.* **15**: 113–200.

Explanation of Plate 14

Figures 1, 2. The original specimens found in the author's garden in Dublin in the spring of 1940.

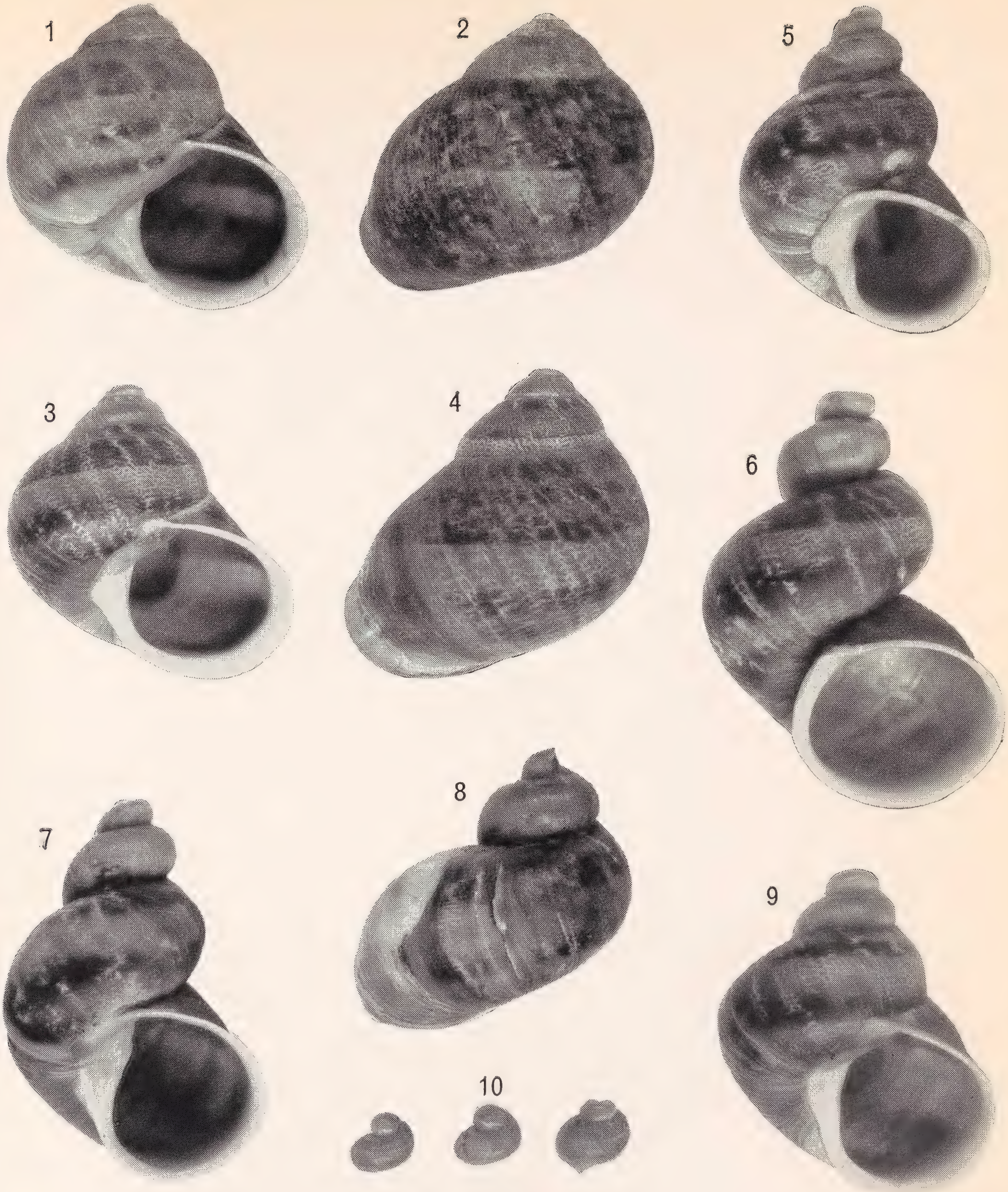
Figures 3, 4. A pair of the F_5 generation, showing the projecting apical whorl (protoconch) which at first suggested that the shells would be scalariform—a characteristic of most specimens of most broods throughout the experiment. This pair never bred.

Figure 5. The first corkscrew to be born. It belonged to the F_5 generation.

Figure 6. A corkscrew belonging to the F_{10} generation. Found dead and removed on 2 September 1961.

Figure 7. Another corkscrew belonging to the F_{11} generation. Found dead on 2 August 1960.

Figures 8, 9, 10. The two corkscrews of the F_{10} generation involved in Pitchford's first mating, and the only three of the F_{11} generation resulting from this mating which were preserved.



Scalariformity in *Helix aspersa* Müller

W. Fowler.

T. G. W. FOWLER at Weymouth, Dorset, with his wife, *c.* 1953

J. Conch. **26**: 333. (1968)

OBITUARY

THOMAS GEORGE WILLIAM FOWLER, 1880–1967

T. G. W. FOWLER was born on 20 August 1880, the son of THOMAS FREDERICK FOWLER of Huntingdon and ANNIE COOTE of Fenstanton, Hunts. He was educated at Harrow and Trinity College, Cambridge. In his younger days he was a well-known climber, and was an honorary member of the Swiss Alpine Club. He had many first class climbs to his credit, but had to give up climbing after a serious attack of brain fever. It is not known what caused him to turn his attention to the Mollusca; he began collecting in 1927 and by the 1930's (when the writer first met him) he was already an experienced collector, specializing in the larger marine species of this country. He dredged extensively, and collected at nearly all the classic localities. His best find was *Divaricella divaricata* (L.) of which he dug up five living specimens on a Tresco (Scilly) beach. Later, he obtained further examples on St Martins, also in Scilly, and these remain the only authentic live-taken British specimens. FOWLER was particularly attracted by 'outsize' specimens and had very many large examples of British marine species. For many years his collection was stored with his bootmaker.

FOWLER joined the Conchological Society in 1929 but had not been a member for a number of years before his death. He lived for some time at Falmouth, but moved to Sennen, Cornwall (where he obtained many specimens of *Janthina*) in November 1943 after his marriage to GLADYS IRENE HUGHES GAGE of Basingstoke, Hants, who was also a member of the Society. He died at Sennen on 4 March 1967.

He collected ceramics, Cornish serpentine, and stamps, as well as Mollusca. Most of his Mollusca went to the British Museum (Natural History) in May 1965, and his conchological books were sold privately. He published very little and I believe the following are all he wrote:

1937 Dredging in Loch Linnhe. *J. Conch.* **20**: 305.
1939 Abnormal *Acanthochitona crinita* Pennant. *J. Conch.* **21**: 141.
1946 A new British *Janthina*. *J. Conch.* **22**: 186, pl. 1.
1947 *Janthina* in Cornwall. *J. Conch.* **22**: 267.
1948 *Janthina pallida* Thompson. *J. Conch.* **22**: 307–308.
1948 On the alleged occurence of *Circulus* in Cornwall. *J. Conch.* **23**: 13.
1949 *Janthina exigua* Lamarck in Cornwall. *J. Conch.* **23**: 49.
1949 *Divaricella divaricata* (L.) in Scilly. *J. Conch.* **23**: 68.
1950 Further note on *Divaricella divaricata* (L.). *J. Conch.* **23**: 98.
1952 *Divaricella* in Scilly: a correction. *J. Conch.* **23**: 266.

NORA F. MCMILLAN

RICHARD TURNER, 1947–1967

RICHARD TURNER died on 24 June 1967 in Addenbrooke's Hospital, Cambridge. He had contracted Hodgkin's disease, a malignant disease of the lymph glands, and went into hospital soon after taking part one of the Natural Science Tripos.

He had a successful and full career at Charterhouse School, and gained his place at Trinity College, Cambridge, before his seventeenth birthday. Before going up to the University he spent a year at the National Institute of Oceanography, where he studied the world literature on bioluminescence; this work was published as an Internal Report of the N.I.O.

RICHARD TURNER was a dedicated scientist with an enterprising and experimental outlook and a particular enthusiasm for the Mollusca. He was attracting increasing attention as a zoologist and a satisfying professional career must have followed in due course. He joined the Society in 1966, and attended meetings frequently. He was a quiet unassuming person, with many friends, and gained increased respect and liking from all as they knew him better. He will be remembered as a gifted scientist and a warm-hearted, friendly personality. His death so tragically early has certainly deprived the Society and the world of Zoology of a most promising member.

CHARLES PETTITT

REVIEWS

Sea Shells of the World: a guide to the better-known species of marine shells by R Tucker Abbott and Herbert S. Zim, illustrated by George and Marita Sandström. London: Paul Hamlyn, 1968. pp. 160, with coloured illustrations on every page. 6″ × 4″. Price 5s (Paperback), 7s 6d (Hardback).

This book (first published in 1962) will already be familiar to many readers, either from one of the American editions or from one of several translations. It has a great deal to recommend it: its handy pocket size, a low price, and nearly 800 excellent illustrations in full colour of world wide shells ranging from the very common to the very rare.

A number of changes have been made for this, the first British edition: the text has been completely reset with the spelling anglicized, a map of the Atlantic Ocean and North Sea [p. 13] replaces the bibliography of the American editions, and eight British species have been included for the first time. Unfortunately the present edition appears to have been taken from an early American issue, as many of the errors which had been corrected in the later American printings now reappear. These range from minor misspellings (*Japalion* for *Japelion* [p. 82]), incorrect authorities (*Murex brassica* [p. 72] was not described by Gmelin but by Lamarck), and incorrect names (*Conus rosaceus* Lamarck [p. 21] should be *C. aurora* Lamarck), to misidentifications ('*Cypraea nivosa*' [p. 62] is actually *C. broderipii*). Indeed, hardly a page is free of an error of some kind. Many of the names attributable to Lightfoot remain attributed to Solander, although those attributed to Humphrey in earlier editions have now been corrected.

On p. 30 the text should read: 'Queen Tegula is a collector's item in [California. Norris' Top Shell is relatively common in] shallow water. Its operculum bears tiny bristles.' In this edition the text within the brackets has been omitted, making nonsense of the remaining statement.

Of the new material added in this edition, most bears the mark of hasty and inadequate preparation. Not one of the new names included has any author cited, and the new illustrations are of considerably poorer quality than the rest. The '*Pholas dactylus*' added on p. 155 is not that species and appears to be a *Barnea candida*. One of our British 'cowries' appears as *Trivia antarctica*! *Patina pellucida* is not in the Acmaeidae, and *Sepia officinalis* hardly belongs under 'Argonauts and Nautilus'.

Undoubtedly, further editions will be required of *Sea Shells of the World* to meet the needs of the ever-growing numbers of shell enthusiasts throughout the world. It is to be hoped that the publishers will submit the text to rigorous revision before republication. Despite the numerous faults which may be found with it, however, this little work is certainly worthy of a place on the bookshelves of every general collector. For the novice there could be no better introduction to the puzzling variety of exotic genera and species, and by the time he is familiar with all the shells depicted in this book he will no longer be a novice.

David Heppell

The Curious World of Frank Buckland by G. H. O. Burgess. London: John Baker, 1967. pp. xii + 242, with 16 pls. 8vo. Price 50s.

In a most readable and entertaining book, Dr Burgess, of the Humber Laboratory for Fish Technology, introduces the reader to what he aptly terms the 'curious world' of Frank Buckland, the eldest son of the geologist Dean William Buckland of Westminster. Frank Buckland is probably best known for his popular writings on natural history collected together in the four-volume *Curiosities of Natural History*. His serious work on salmon and oyster cultivation and on the acclimatization of exotic animals to provide food for the hungry masses is perhaps less well known than it deserves to be. Probably the most interesting aspect of Buckland was his eccentric private life and the odd company he kept. All these facets of his life, which reflect in addition, fascinating glimpses of early Victorian life, are ably presented in this work.

Buckland's taste for natural history was encouraged by his father from a very early age. There is an amusing story of how the four-year-old 'Frankie' dumbfounded a clergyman who had travelled from Devonshire to Oxford to show some 'very curious fossils' to the Dean, who passed them to his son. '"They are the vertebrae of an ichthyosaurus," lisped the child, who could not yet speak plain.' Like his father, FRANK BUCKLAND would cook and eat almost any animal to satisfy his curiosity, and seens to have been particularly fond of roast field-mice when at school.

He trained as a surgeon at St George's Hospital, and developed a great respect for JOHN HUNTER, the eighteenth-century surgeon. On hearing that the crypt of St Martin-in-the-Fields, where HUNTER's coffin rested, was to be sealed, BUCKLAND determined to have his hero's remains re-interred in Westminster Abbey. The macabre story of his efforts, briefly recounted here, is told at some length in the 4th series of the *Curiosities*.

BUCKLAND could never resist a visit to the travelling sideshows that were common in the London of the time, at which mermaids, talking fish, petrified mummies, human cannon balls, and the like were proudly exhibited. He also sought the company of giants, dwarfs, and other human 'freaks', and among his friends were CHANG and ENG BUNKER, the original Siamese twins, and CHRISTINE-MILLIE, the Two-Headed Nightingale, who 'could dance equally well on two legs or four'.

Such was the background to the man who was ever ready to popularize natural history, especially its economic aspects, giving lecture tours at the Brighton Aquarium or at his own Museum of Economic Fish Culture in South Kensington, editing the weekly journal *Land and Water*, which he had established in 1866 in opposition to the *Field*, and travelling widely in his capacity of Inspector of Salmon Fisheries. Dr BURGESS's book is crammed with informative and amusing anecdotes spanning the years from BUCKLAND's schooldays at Winchester College to his death in 1880, and a useful bibliography of BUCKLAND's major writings is appended.

DAVID HEPPELL

Molluscs by J. E. MORTON. 4th (revised) edition. London: Hutchinson University Library, 1967. pp. 244, with 41 text-figs. 8vo. Price 13s 6d (Paperback), 32s 6d (Hardback), $5.50 in US.

The author approaches diversity among the Mollusca with the outlook of an evolutionary biologist and a functional morphologist. The phenomenal radiations within each class are discussed in terms of the adaptive significance of the evolved anatomical, behavioural and phsyiological features. A brief informative résumé of the six classes of molluscs accents the morphological and developmental characteristics which serve to unite such diversified organisms into a single phylum.

In greater detail (Chapters 2, 9, 10, 11) he surveys the gastropods, bivalves and cephalopods. External form, including shape or ornamentation of the shell, is discussed in relation to ecological and evolutionary trends evident in these classes. The systematic hierarchy of the subclasses, orders and families is introduced. The phenomenon of convergence is highlighted in the gastropods where independent lineages have progressively lost the shell altogether or have separately evolved, for example, a patelliform or cap-shaped shell. The bivalves, more or less sedentary creatures, have specialized in modes of burrowing or attachment to the substrate and can be contrasted with the cephalopods which have opted for a swimming or nectonic existence and have developed an astonishing array of spectacular adaptive features, including, of course, eyes which rival those of the vertebrates in their acuity.

In chapters 4 to 8, anatomical systems and physiological adaptations are presented with an emphasis on the relationship between evolutionary trends and morphological modifications. Concerning the organs of the mantle cavity, the author describes the structure of the gill, its reduction, simplification and replacement by secondarily derived breathing organs in the gastropods as they invaded fresh-water and terrestrial habitats. The ctenidial elaboration in the bivalves evolved as the gill became an organ for feeding and even brooding the young. The structural and biochemical features of the alimentary canal are correlated with feeding habits. The physiology of circulation and excretion and the biology of reproduction are discussed in chapters 6 and 7 while the aspects of the nervous system and sense organs are treated in chapter 8. The compaction and cephalization of the nerve ganglia in cephalopods and higher gastropods are contrasted with the simple structures of the bivalves and amphineurans.

Professor MORTON has revised his text which first appeared in 1958 and has included the two most publicized recent discoveries in malacology, namely the living monoplacophoran *Neopilina* and the bivalved gastropod *Tamanovalva*. Data from some of the important sources which have appeared in the 1960's are also incorporated (e.g. FRETTER & GRAHAM on British Prosobranchs; WILBUR & YONGE on the physiology of Mollusca; BULLOCK & HORRIDGE on the nervous systems of invertebrates). In addition, the number of figures has been increased.

A singular annoyance for the serious student is the frequent mention of research results without adequate citation. The book is somewhat parochial in that marine species are given a nationality (e.g. the 'British *Buccinum*'); reference to zoogeographical regions might be more meaningful. Although newly published interpretations (e.g. GHISELIN, M. T., 1966. The adaptive significance of gastropod torsion. *Evolution* **20**: 337–348; VAGVOLGYI, J., 1967. On the origin of molluscs . . . *Syst. Zool.* **16**: 153–168) supplant some of the theories discussed by Professor MORTON, this book serves as an excellent introduction for the study of the biology of the Mollusca.

KENNETH J. BOSS

Marine Shells of the Pacific by WALTER O. CERNOHORSKY. Sydney: Pacific Publications Pty Ltd, 1967. Distributed in the UK by W. R. Carpenter & Co., London. pp. 248, including 60 plain pls. of 444 figs. + 21 text-figs. 8¾ × 5¾. Price A$6.50.

This book is evidently an abridgment, for popular consumption, of its author's studies of the marine molluscs of Fiji published in recent issues of the journal *Veliger*. Nearly all of the illustrations have appeared in that journal and so has much of the text. Not everyone has access to *Veliger*, however, and it is useful anyway to have the information brought together in one handy volume. Most of the illustrations are adequate for identification although the outlines of some of the shells merge confusingly into the dark backgrounds. The following families are covered: Bursidae, Cymatiidae, Colubrariidae, Cypraeidae, Ovulidae, Triviidae, Muricidae, Mitridae, Olividae, Terebridae and Conidae. As far as favourite collectors' groups are concerned this is a reasonable coverage—but what about the rest of the Pacific molluscan fauna? If the volume is the first of a series this should have been stated; if it is not then the title should have indicated the limited coverage of the contents.

The introductory matter, less than a quarter of the whole, is of variable quality. Some of the sections will be useful, particularly those dealing with the removal of radulae, collecting techniques, arranging a shell collection, and photography of shells (this last is probably the most detailed account of its kind yet published in book form). Other sections are not so useful. That on early collectors, collections and expeditions (which is largely about books) is so inaccurate that few paragraphs are above criticism: 'This colour-plate work, known as *Systematisches Conchylien-Cabinet*, was continued after 1829 by SCHUBERT and WAGNER and was finally completed by KUESTER in 1900' (p. 18); the first edition of that book was completed *in* 1829, the second was completed in 1920, and KUESTER died in 1876. That sort of thing won't do, but it's done with gay abandon in this section. The section on classification is too sketchy to be of much use although the only error noticed is the omission of Scaphopoda from the list of classes comprising the phylum Mollusca. That on the use of shells is mostly concerned with the nasty things some of the contained animals do to man and is otherwise not very informative. The 'categories of type-terms' lists those oddities *homeotype* and *hypotype* but omits *syntype*. The Glossary gives 'Malacology—The study of the animals of molluscs' and 'Malacozoology—The study of living molluscs in relation to their animate and inanimate environment': the first of these terms is an abbreviation of the second and both should imply the study of molluscs in the widest sense. The Index is confined to the species discussed; but why give species and genus names for senior synonyms and species names only for junior synonyms?

Collectors are well satisfied if a book contains many illustrations of shells and if the scientific names are reliable. Mr CERNOHORSKY should have satisfied them in these respects.

S. P. DANCE

Your Book of Shell Collecting by L. W. STRATTON. London: Faber and Faber Ltd, 1968. pp. 64, with 8 plain pls., coloured frontispiece, and 28 text-figs. 8vo. Price 13s 6d.

This book is an attempt to present the 'how, when and where' of collecting British shells, both marine and non-marine, from an ecological viewpoint, and is particularly aimed at schoolchildren from 11 to 16. The presentation is summed up by the author on p. 22: 'You can only collect in one habitat at a time, so I am going to take habitats, tell you something about them and the sorts of shells you may expect to find in them.' With few exceptions, only the larger and more common species are included. The text-figures, by Mrs CYNTHIA O'BRIEN, are excellent and it is a pity there are not more of them as the descriptions of the shells are minimal. Some Scottish readers may indeed take exception to the statement [p. 50] that 'The Common Snail (*Helix aspersa*) needs no description'. This book is not intended as an aid to identification, however, and the beginner should use it in conjunction with an illustrated work such as STEP's *Shell Life*.

The eight plain plates show various habitats and mention is made in the text of their characteristics and the kinds of shells likely to be found in them. The slugs are omitted, except for *Testacella*, and it is curious that *Ena montana* and *Euconulus fulvus*, for instance, are included while the commoner *Ena obscura* and *Vitrina pellucida* are not. As the author states on p. 51, however: 'Many shelled molluscs have had to be left out . . . because there is not room for them all. If you collect all the species that have been written about, you will have made an excellent start to your shell collecting'.

The author writes from the point of view of a shell collector rather than a zoologist and some of his statements in the chapters on Classification and The Parts of a Shell should not be taken too literally. For instance [p. 15], Mammals, Birds, Fishes and Insects are *classes* not *phyla*, and it is not true to say that: 'The animal, by means of its fleshy mantle, extracts calcium from the water or from its food . . .'. Similarly it is no longer true that 'all the lung-breathing molluscs are placed together in the order Pulmonata' [p. 17]. Not all the British marine gastropods have an operculum, as is suggested on p. 20, and it is certainly not true that bivalves have no mouths.

Setting these reservations aside, however, the book may be recommended as a useful work for stimulating and channeling young people's awakening interests in shells and shell collecting. The later chapters offer some useful advice and information on Preserving and Recording, Apparatus and Equipment, Societies and Publications, and Museum Collections, indicating where in Britain public shell collections may be seen.

DAVID HEPPELL

Van Nostrand's Standard Catalog of Shells edited by R. J. L. WAGNER & R. T. ABBOTT. 2nd edition. Princeton, N.J. and London: D. Van Nostrand, 1967. pp. xi + 304, with illustrated covers and numerous text-figs. $8\frac{3}{8}'' \times 5\frac{1}{2}''$. Price 48s.

The first edition of this *Catalog* has previously been reviewed in this Journal [**25**: 363–365]. This second edition is considerably enlarged, with 114 extra pages, and a number of genera are now included, either completely or in part, for the first time. These include *Nerita*, *Cassis*, *Distorsio*, *Charonia*, *Tonna*, *Coralliophila*, *Latiaxis*, *Babylonia*, *Columbarium*, *Marginella* (comprising 37 pages of about 1300 names), and *Terebra* among the gastropods, while bivalves (*Hippopus*, *Tridacna*) and cephalopods (*Nautilus*) are entirely new to the lists. In *Cypraea*, names have increased from 700 to 850, although only 5 more valid species are recognized, and many fresh entries have been made under other genera listed previously. Additions to the synonymy and price revisions occur in nearly all genera. Two new coloured covers make their appearance, including one of Marginellidae, while the original coloured covers have been retained inside.

The price of many rarities has fallen as a result of further finds by collectors: *Cypraea guttata* is down from $1400 to $950 while the biggest drop of all is for *Conus gloriamaris*, from $2000 for a specimen with operculum to $650, the number of known specimens having rocketed from around 30 to over 70. The recent discovery of the third known *Cypraea leucodon* has made it even more desirable, however, since its price is up from $1500 to $2000, while the biggest increase of all, possibly as a result of the publicity afforded it in PETER DANCE's book on *Shell Collecting*, is for *Conus milneedwardsi* which leaps from $300 to $1300.

The world size records are now grouped together in a separate section at the end of the book and two new regional 'quick lists' have been added, for the British Isles and Southern Australia. The highest priced British shell is the pelagic *Carinaria mediterranea* at $20 which is no doubt a fair price, but some of the others seem based on little more than guesswork. Many British collectors would gladly pay 8c for an *Erato voluta* or *Mactra glauca* if a supplier could be found, and 20c for *Limea sarsi* or 50c for *Pinna fragilis* must also be considered bargain prices. At the other extreme we could all get rich quick if *Skeneopsis planorbis* could really be sold for 3c each, or *Pecten maximus* for $1.

The value of this work, both as a convenient check-list and synonymy of the genera included, and as a guide to the fluctuating prices of the shell markets, has now been proved, and one looks forward to future editions with some eagerness.

DAVID HEPPELL

Oceanography by M. GRANT GROSS. Columbus, Ohio: Charles E. Merrill, 1967. Distributed in the UK by Prentice-Hall International. pp. viii + 135, 71 text-figs. 23 × 15 cm, laminated cover. Price 14s (Paperback), 32s (Cloth).

This is a very readable introduction to the growing discipline of oceanography, and also includes much information which makes it a handy reference book; the emphasis is on physical, rather than biological, oceanography. It is one of the Merrill Physical Science series, each of which has been written as a self-contained volume designed for a short integrated University course bridging the more traditional scientific disciplines.

There are chapters on Earth, the Water Planet; the Ocean Floor; Deep-sea Sediments; Water and its properties; Sea Water; the Open Sea; Ocean Currents; Waves and Tides; and Shallow and Coastal Oceans. Each chapter ends with a short list of questions and, although no answers are provided, they enable the reader to gauge whether he has grasped the principles expounded in the chapter. The figures are excellent, with very original presentations being used to bring out the scheme behind the facts. The book ends with a short appendix of conversion factors etc., and there is a reasonable seven-page index.

Besides being of general interest, conchologists should find the explanations of the mechanics of currents, beaches, reefs and estuaries of great assistance in understanding the distribution of marine life and other problems. The explanation of shoreline changes and the chapter on sediments should help palaeontologists to understand better the forces which have shaped the present land masses and their fossil deposits.

Thus in this book the basic facts about the Ocean are brought together in a small compass and the underlying principles governing its effects are well illustrated. I feel it may be thoroughly recommended to anyone with more than a passing interest in the sea that surrounds our Island.

CHARLES PETTITT

Israel Program for Scientific Translations.

Two titles from this series have recently been reviewed in this Journal: *Cephalopods of the Seas of the U.S.S.R.* by I. I. AKIMUSHKIN, and *Shell-bearing Mollusks (Loricata) of the Seas of the U.S.S.R.* by A. M. YAKOVLEVA. We have been advised that the agents for the distribution of this series in the U.K. is now H. A. Humphrey Ltd, 5 Great Russell Street, London W.C.2.

ACCOUNTS FOR THE YEAR ENDING 31 DECEMBER 1967

Income and Expenditure Account

Dr.

	£	s.	d.	£	s.	d.
To Fees and Subscriptions:						
Membership Fees	723	5	0			
Subscribers	241	5	9			
Entrance Fees	20	10	3			
				985	1	0
Donations				110	0	6
Sales:						
Old Journals (part payment)	790	3	1			
Advertising	23	19	6			
Journals	29	11	2			
Authors' Separates	7	4	11			
Newsletter	5	18	3			
Papers for Students	18	10	0			
Sundry Receipts	4	16	9			
				880	3	8
Profit on Sale of Investment				25	11	2
Investment Income:						
General Account	66	1	1			
Life Membership Fund	25	0	0			
Reserve and Research Fund	37	0	0			
	128	1	1			
Transfer to Reserve and Research Fund	37	0	0			
				91	1	1
				£2091	17	5

Cr.

	£	s.	d.	£	s.	d.
By Publications:						
Journal:						
Vol. 26, No. 3	336	13	8			
Authors' Separates	14	10	2			
Vol. 26, No. 4 (part payment)	19	3	6			
	370	7	4			
Newsletter	224	10	7			
Papers for Students	105	15	4			
				700	13	3
Field Meetings				18	8	1
Meetings				12	10	8
Bank Charges					10	0
Printing, Stationery and Postage				141	19	5
Officers' Expenses				60	15	9
Subscriptions				7	15	0
Sundry Expenses				6	18	3
				949	10	5
Net Surplus				1142	7	0
				£2091	17	5

Balance Sheet

Dr.

LIABILITIES	£	s.	d.	£	s.	d.
To Fees and Subscriptions in advance				149	6	5
Life Membership Fund				710	0	0
Reserve and Research Fund				1086	0	0
Capital Stock				800	0	0
Capital Account:						
Balance Bt/Fwd.	1068	16	4			
Add Surplus	1142	7	0			
				2211	3	4
				£4956	9	9

Cr.

ASSETS	£	s.	d.	£	s.	d.
By Cash at Bank:						
Current Account	652	1	0			
Deposit Account	825	11	9			
				1477	12	9
Investments:						
£400 5% Treasury Stock 1986/89 (£310. 0. 0)	344	0	0			
£500 5¾% Deb. Stock Mersey Docks & Harbour Board 1976/78 (£427. 10. 0)	460	17	0			
£500 6¾% Stock Greater London Council 1976 (£491. 17. 6)	505	0	3			
614 Units M. & G. Dividend Fund (£327. 9. 4)	349	15	9			
£650 6¾% Loan City of Birmingham	650	0	0			
£400 5⅝% Loan City of Norwich	400	0	0			
£800 5½% Loan London County Council	769	4	0			
				3478	17	0
				£4956	9	9

Examined and found correct.
M. MAITLAND HOWARD }
CHARLES W. PETTIT } Auditors.

MARJORIE FOGAN,
Hon. Treasurer.
12 February 1968.

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

MEMBERS ELECTED

842nd Meeting, 18 November 1967

Kenneth John Adams, b.sc., ph.d., 17 Cedar Close, Albert Road, Buckhurst Hill, Essex.
Revd A. A. Bain, 40 Clive Avenue, St Annes, Lytham St Annes, Lancs.
James Bourne, Elms Farm, Bromham, Chippenham, Wilts.
Richard L. Casanova, d.sc., Director, Paleontological Research Laboratory, 3616 Garden Club Lane, Charlotte, North Carolina 28210, U.S.A.
Errol Clive Roger Dunk, d.a.d., 3 Bennett Park, London S.E.3.
Gerald Eastwood, 4 St Peg Close, Cleckheaton, Yorkshire.
C. Gillard, The School House, West Buckland, Wellington, Somerset.
Alberto Girod, via Savona 94/A, 20144 Milano, Italy.
Miss Barbara E. Hart-Jones, Glenview, 2 Sardis Cross, Milford Haven, Pembs.
Mrs Jean Kline, b.a., 11 Grove Park, Knutsford, Cheshire.
Miss Joan Lovenack, b.sc., 35 Wilmot Road, London N.17.
David Wood McKay, 27 Springfield Road, Aberdeen, AB1 7RJ.
Northants Natural History Society and Field Club, c/o Mrs W. Cowley, Hon. Secretary, 83 Beech Avenue, Northampton.
Oslo Zoologisk Museum, Sars Gt. 1, Oslo 5, Norway.
Robert Forrest Preston, 13 Round Hill, London S.E. 26.
Mrs E. B. Rands, 51 Wychwood Avenue, Luton, Beds.
Alan Skene, m.b.e., m.a., The Mount, Stromness, Orkney.
Mrs Gillian Slator, s.r.n., 16 The Pines, Cromwell Lane, Tile Hill, Coventry, Warwickshire.
C. Swaneveld, The Oaks, Waterloo Green, Wynberg, Cape, South Africa.
Günther Trappe, Colegio Aleman, Apartado 561, Vigo, Spain.
Paul Warriss, 6 Royal Albert Road, Westbury Park, Bristol 6.
H. Watts, 28 Portman Road, Kingston upon Thames, Surrey.

843rd Meeting, 16 December 1967

R. A. D. Cameron, b.a., Department of Biological Sciences, Portsmouth College of Technology, Hay Street, Portsmouth, Hants.
Cornély Guy, 11 rue Beffroy, Rouen 76, France.
R. G. Llewellyn Jones, Honan, West Mersea, Colchester, Essex.
George J. M. Visser, Langewaal 7, De Waal, Texel, Netherlands.

844th Meeting, 20 January 1968

Miss Gillian Ann Charlish, 22 Ednam Road, Goldthorn Park, Wolverhampton, Staffs.
Fernando Fernandez Lozano, Santa Marta 62 (Bajo), Vigo, Spain.
Mrs Kathleen June McRae, Box 31, Post Office, Rabaul, New Guinea Territory.
New Zealand Oceanographic Institute, P.O. Box 8009, Wellington, New Zealand.
Peter L. Percharde, Trinmar Ltd, Point Fortin, Trinidad and Tobago.
Dr Andor Richnovszky, Dozsa Str. 12–14, Baja, Hungary.
Miss Norah Mary Dafne Treneman, 3 Elthiron Road, London S. W.6.
Martin Way, Westwynds, 1 Timms Road, Banbury, Oxon.
P. E. White, 54 St Julian's Farm Road, London S.E.27.

The following Junior Members transferred to full membership:
Simon Davis, 8 Tongdean Road, Hove 4, Sussex, BN3 6QB.
Miss Rosemary Wilkinson, 23 Hazon Way, Epsom, Surrey.

845th Meeting, 17 February 1968

Flt Lt Peter Anthony Hall, 22 Norfolk Road, Cliftonville, Margate, Kent.
Flt Lt Douglas A. J. Taylor, B.E.M., Fairy Point Officers' Mess, Royal Air Force Changi, G.P.O., Singapore.

846th Meeting, 16 March 1968

Sergio Angeletti, 20 via C. Pascarella, I–20157 Milano, Italy.
Dario A. Franchini, 37 via Cremona, 46100 Mantova, Italy.
Keith Paterson, New College, Oxford.
Michael F. Perry, Petty Officers' Mess, H.M.R.Y. Britannia, B.F.P.O. Ships.

The following Junior Member transferred to full membership:
B. M. Thistleton, 22 Alvington Road, Carisbrooke, Newport, Isle of Wight.

MEMBER DECEASED

H. Scaff.

ANNUAL REPORTS

Presented to the 845th (Annual General) Meeting, held at the British Museum (Natural History), 17 February 1968

Mr S. P. Dance, President, in the Chair.

Appointment of Scrutineers

Mr M. R. Block and Mr P. E. Negus were appointed Scrutineers.

Election of Auditors

Mr A. Norris and Mr C. W. Pettitt were elected Auditors.

Report of the Council

Membership. The Society has in the past year had to suffer grievous losses through the death of five of its Members, three of them eminent scientists of international fame: Dr H. E. Quick—past President and Honorary Member, Dr W. J. Rees, and Robert Rendall; also two young and promising biologists, R. J. Turner and H. Scaff. Fourteen Members resigned and twelve were deleted from the lists. Two were restored after payment of arrears and fifty-six new Members were elected, two of whom were already Junior Members. Total Membership is now 401, a net gain of 27, and of these 17 are Life and 3 are Honorary Members.

Meetings. One annual general meeting and seven ordinary meetings have been held at the British Museum (Natural History), by kind permission of the Trustees, the average attendance being 42. Field meetings were also held.

Publications. One issue of the *Journal of Conchology* was published; this, although dated in March, appeared in June. Of the *Conchologists' Newsletter*, issues (Nos. 20–23) were made in March, June, September and December; *Papers for Students* Nos. 8 and 9 also appeared.

Most back-numbers of the *Journal* up to the end of Vol. 24 are now available from the Johnson Reprint Co., and later editions through the Hon. Secretary. *Papers for Students*, when in print, can be had from the Junior Section Leader.

Publicity. The redesigned Prospectus and Nomination Form were issued and are in general use. The Society's Film has been compiled and edited, and is now in an advanced state of preparation.

Mr C. W. Pettitt has continued to attend the Meetings of the Biological Council as representative of the Society.

Treasurer's Report

It is a pleasant to be able to report an increase in revenue from both Members' Annual Subscriptions and from Subscribers, although despite reminders about thirty Members are still in arrears with 1967 Annual Subscriptions.

During the year the Society was fortunate in receiving a Donation of £100. For this we are indebted to a former President, Capt. C. R. P. DIVER, C.B., C.B.E., M.A., F.L.S., F.R.G.S., and we are pleased to place on record the Society's thanks for his generosity.

Receipts from the Johnson Reprint Co. in respect of the sales of old Journals amounted to £790, and this, together with a portion of the previous instalment received in 1966, has enabled the Society's investments to be considerably increased during 1967. The holding of 4% British Gas was sold, and the proceeds of this sale were reinvested. As a result of these transactions an increase in the investment income will be apparent in 1968. The figure shown in the Balance Sheet of investment income appears low because the return of Income Tax claimed was not received in time for inclusion.

It must be pointed out that the expenditure shown on Vol. 26 No. 4 of the *Journal* covers only preliminary expenses for blocks, and the main cost (estimated to be in the region of £450) will be due early in 1968, and will materially reduce the favourable credit balance shown.

Although the allocation of expenditure to the Society's various activities is shown, it is a fact that in all cases the basis of the expenditure is paper, printing, duplicating and postage, all of which have continued to rise in cost. The effect of increases in postal charges, dating from the autumn of 1966, is now apparent for a full year, and unfortunately it appears probable that further increases may be expected here and in the other items described.

It may be possible to put into operation a scheme for the payment of Members' Annual Subscriptions by means of Seven Year Covenants. If this proves feasible a circular will be sent out explaining the scheme and it is hoped that all Members will consider seriously the possibility of taking part, as in view of the previously mentioned probability of increased costs the extra revenue would prove of immense benefit to the Society.

I should like to conclude upon a personal note, in thanking all those who have assisted me in the difficulties of a newcomer to the Treasurership—my predecessor, Mr C. A. RAFFRAY, for his help; Mr T. E. CROWLEY, who has been a tower of strength; the Council, for patience and advice, and all the Members of the Society who have given such excellent support.

MARJORIE FOGAN

Recorder's Report: non-marine Mollusca

A. 10-KILOMETRE SQUARE MAPPING

Excellent progress is being maintained, about 33,500 post-1950 records having been incorporated to date. The widespread interest which the mapping scheme has aroused is reflected in the exceptionally large number of new vice-comital records which appear in the list below. In Ireland, regrettably, recording remains virtually at a standstill; clearly special visits will have to be organized if anything worthwhile is to be achieved.

The second progress map appeared in *Newsletter* No. 24, March 1968, p. 30.

B. VICE-COUNTY RECORDS

The following have been verified since the last Recorder's report (*J. Conch.* **26**: 287):

Channel Isles (0): *Arion lusitanicus*, Pointe de la Moye, Guernsey; *Agriolimax caruanae*, Guernsey (widespread), both A. E. ELLIS, May 1967.

Cornwall East (2): *Monacha cantiana*, Cremyll, opposite Plymouth; *Vitrina major*, near Luckett, both Mrs J. A. PATON, March 1967.

Somerset North (6): *Milax sowerbyi*, Weston-super-Mare, G. WHITFIELD, June 1967; *Limax cinereoniger*, Burrington Combe, D. G. PICKRELL, May 1967.

Wilts North (7): *Oxychilus draparnaudi*, Bradford on Avon, D. C. LONG, August 1967.

Isle of Wight (10): *Agriolimax caruanae*, Ventnor, R. FRESCO-CORBU, April 1967.

Hants North (12): *Lymnaea auricularia*, *Anodonta anatina*, *Pisidium moitessierianum*, R. Wey near Bentley, M. P. Kerney, November 1967; *Vitrina major* (empty shell), The Hanger, Selborne, Miss June Chatfield, November 1967; *Milax budapestensis*, Farleigh Wallop, L. Lloyd-Evans, October 1967; *Pisidium obtusale*, near Basingstoke, M. R. Block, 1967; *Pisidium pulchellum*, R. Test at Laverstoke, M. P. Kerney, October 1967.

Sussex East (14): *Helicella elegans*, ⅔ mile NE. of Denton, A. W. Jones, September 1967; *Oxychilus helveticus*, Iford, M. P. Kerney, July 1967.

Kent West (16): *Pisidium nitidum*, Tonbridge, E. G. Philp, 1967.

Surrey (17): *Arion lusitanicus*, East Sheen (garden), Miss P. Halliday, May 1967; *Agriolimax caruanae*, South Croydon, Miss S. M. Davies, May 1967.

Essex South (18): *Hygromia striolata*, near Rochford, D. Boxley, July 1967; *Agriolimax caruanae*, Sewardstone, L. Lloyd-Evans, February 1968.

Essex North (19): *Milax budapestensis*, Felsted, M. P. Kerney, February 1967; *Pisidium pulchellum*, R. Chelmer at Little Waltham, M. P. Kerney, June 1967.

Suffolk East (25): *Planorbis vorticulus*, Carlton Colville Marshes, D. C. Long, September 1967; *Arion subfuscus*, Oulton Broad, D. C. Long, November 1967; *Milax budapestensis*, *Pisidium casertanum*, Carlton Colville Marshes, D. C. Long, March 1967.

Suffolk West (26): *Potamopyrgus jenkinsi*, R. Lark near West Stow, D. Boxley, August 1967; *Ancylus fluviatilis*, R. Stour near Wixoe, M. P. Kerney, June 1967; *Ena montana*, just N. of Lavenham (roadside bank), L. Lloyd-Evans, April 1967; *Oxychilus draparnaudi*, near Brandon, M. P. Kerney, August 1967.

Norfolk West (28): *Milax sowerbyi*, Holme next the Sea (garden), L. Lloyd-Evans, October 1962; *Pisidium personatum*, near Didlington Park, L. Lloyd-Evans, May 1967; *Pisidium supinum*, Little Ouse at Wilton Bridge, Hockwold, L. Lloyd-Evans, June 1967.

Cambridge (29): *Viviparus viviparus*, R. Lark 2 miles S. of Littleport, L. Lloyd-Evans, April 1967.

Bedford (30): *Potamopyrgus jenkinsi*, Goldington, J. E. Cooper, September 1940; *Truncatellina cylindrica* (seg.), on sandy bank among *Sedum*, below churchyard wall, Potton, L. Lloyd-Evans, May 1967.

Hunts (31): *Oxychilus draparnaudi*, *Milax budapestensis*, Orton Longueville (garden), Miss Mary Pugh, July 1967.

Gloucester East (33): *Vertigo pusilla*, The Whiteway above Baunton, L. W. Grensted, August 1956; *Oxychilus helveticus*, near Sherborne, D. C. Long, January 1968; *Agriolimax caruanae*, Prestbury (garden), D. C. Long, June 1967.

Gloucester West (34): *Acicula fusca*, Horsley Wood near Nailsworth, D. C. Long, October 1967; *Pseudamnicola confusa*, 'Shirehampton', specimens in Bristol Museum submitted by D. G. Pickrell, collected before 1900; *Planorbis crista*, near Highleadon, D. C. Long, January 1968; *Zonitoides excavatus*, near Bream, D. C. Long, October 1967.

Warwick (38): *Physa* cf. *P. acuta*, near Solihull (canal), M. W. Rowe, November 1967; *Helicella caperata*, near Lighthorne, M. W. Rowe, April 1967; *Oxychilus draparnaudi* (garden), *Vallonia pulchella*, Leamington Spa, M. W. Rowe, April 1967; *Milax budapestensis*, *Agriolimax caruanae* (both from gardens), Leamington Spa, I. K. Dawson, April 1967.

Stafford (39): *Oxychilus draparnaudi*, Cheadle, W. E. Alkins, April 1967.

Merioneth (48): *Phytia myosotis*, near Gogarth, J. O.'N. Millott, May 1967.

Caernarvon (49): *Valvata cristata*, Vaynol Park Pond, L. S. Bellamy, January 1967; *Cecilioides acicula*, Llanfairfechan, S. P. Dance, July 1967.

Flint (51): *Milax budapestensis*, Prestatyn, Mrs M. Fogan, September 1967.

Lincoln South (53): *Helicella caperata*, near Welby, September 1954; *Helicella gigaxi*, *Oxychilus draparnaudi*, *Milax budapestensis*, near Welby, November 1967, all G. W. Pitchford.

Lincoln North (54): *Milax budapestensis*, Lincoln (garden), H. W. Waldén, October 1962.

Leicester (55): *Valvata cristata*, *Vertigo antivertigo*, *Punctum pygmaeum*, *Retinella radiatula*, in or by Ashby Canal near Higham, M. P. Kerney, May 1967.

Derby (57): *Pisidium obtusale*, Brierlow Bar near Buxton, J. Armitage, April 1952.

Lancaster West (60): *Phytia myosotis*, near Heysham, B. Dennison, June 1967; *Limax cinereoniger*, Tunbrook and Redscar Woods, Preston, E. Greenwood, July 1967.

York South-east (61): *Columella edentula*, by Hornsea Mere, A. NORRIS, April 1967.

York North-east (62): *Hydrobia ulvae*, near Redcar, J. O'N. MILLOTT, 1925; *Hygromia liberta*, Rievaulx, Mrs J. A. PATON, September 1967.

York Mid-west (64): *Vitrea diaphana*, Tarn House Wood, Malham (second British locality), L. W. STRATTON, 1955; *Milax sowerbyi*, Leeds, A. NORRIS, March 1967.

Cheviotland (68): *Pisidium lilljeborgii*, Cragside, Rothbury, R. H. LOWE, September 1967.

Renfrew (76): *Milax gagates*, Renfrew; *Milax budapestensis*, Neilston, both R. M. DOBSON, 1962.

Lanark (77): *Milax gagates*, Cambuslang; *Milax sowerbyi*, Springburn; *Milax budapestensis*, Glasgow, all R. M. DOBSON, 1962.

Roxburgh (80): *Clausilia dubia*, *Oxychilus draparnaudi*, Castleton, Mrs M. FOGAN, July 1967.

Edinburgh (83): *Milax budapestensis*, Corstorphine, Edinburgh, A. R. WATERSON, 1953 (garden, absent in 1939); *Pisidium lilljeborgii*, Duddingston Loch, Edinburgh, Dr SHELAGH SMITH, June 1967.

Stirling (86): *Milax budapestensis*, near Milngavie station (now in Dunbarton), R. M. DOBSON 1962.

Kincardine (91): *Helicella caperata*, *Helicella virgata*, *Agriolimax caruanae*, St Cyrus Nature Reserve, J. G. D. GREENWOOD, November 1967.

Aberdeen North (93): *Agriolimax agrestis* (seg.), Milton near Huntly, E. KELLOCK, October 1967.

Banff (94): *Pupilla muscorum*, Boyne Bay, E. KELLOCK, November 1967; *Hygromia striolata*, Portsoy, (garden), E. KELLOCK, May 1967; *Hygromia hispida*, near Forglen church, E. KELLOCK, March 1967; *Agriolimax caruanae*, W. of Rothiemay, E. KELLOCK, April 1967.

Elgin (95): *Physa fontinalis*, lake in grounds of Gordon Castle, Fochabers, I. D. FINNEY, July 1967; *Lauria anglica*, Speymouth Forest, Fochabers, I. D. FINNEY, July 1967; *Hygromia striolata*, near Forres (waste ground), I. D. FINNEY, May 1967; *Zonitoides excavatus*, Darnaway Estate at Whitmire, I. D. FINNEY, June 1967; *Agriolimax agrestis* (seg.), Orton, SW. of Fochabers, E. KELLOCK, November 1967; *Pisidium pulchellum*, Loch of Blairs, Forres, I. D. FINNEY, May 1967.

Easterness (96): *Hygromia striolata*, 1 mile SSW. of Inverness (waste ground), I. D. FINNEY, March 1967; *Hygromia hispida*, near Nairn, I. D. FINNEY, May 1967.

Main Argyll (98): *Vallonia excentrica*, Tighnabruaich, A. R. WATERSTON, August 1967.

Dunbarton (99): *Milax gagates*, *Milax sowerbyi*, Dumbarton; *Milax budapestensis*, Helensburgh, all R. M. DOBSON, 1962.

Mid Ebudes (103): *Potamopyrgus jenkinsi*, *Pisidium lilljeborgii*, *Pisidium hibernicum*, Loch Cliad, Isle of Coll, Miss L. GARRAD, June 1967.

Ross West (105): *Pisidium hibernicum*, Applecross, L. LLOYD-EVANS, July 1967.

Ross East (106): *Planorbis albus*, *Planorbis crista*, Loch Lundie, near Munlochie, I. D. FINNEY, May 1967; *Ena obscura*, between Bonar Bridge and Spinningdale, I. D. FINNEY, April 1967.

Sutherland East (107): *Hygromia hispida*, north of Dornoch, I. D. FINNEY, April 1967.

Caithness (109): *Acanthinula lamellata*, by Dunbeath Water, WNW. of Dunbeath; *Oxychilus draparnaudi*, by Loch Watten, both I. D. FINNEY, April 1967.

Shetland (112): *Hydrobia* cf. *H. ventrosa* (seg.) [shells only examined], Kergord; *Potamopyrgus jenkinsi*, Loch of Clickhimin; *Retinella nitidula*, Okraquoy, Mainland; *Arion subfuscus*, *Milax sowerbyi*, *Agriolimax caruanae*, near Loch of Clickhimin (waste ground); *Milax budapestensis*, Kergord (plantation), all Mrs M. FOGAN, July 1967; *Clausilia bidentata*, near stack of Okraquoy, F. MAY, July 1967.

Kerry South (H 1): *Agriolimax caruanae*, by Lough Currane, Waterville, Mrs N. F. McMILLAN, May 1967.

Kerry North (H 2): *Vitrina* cf. *V. pyrenaica*, below Torc Cascade, Killarney, Mrs J. A. PATON, August 1966; *Agriolimax caruanae*, near Killorglin, R. T. HERBERT, March 1967.

Cork West (H 3): *Agriolimax caruanae*, Glengariff, Mrs N. F. McMILLAN, June 1967.

Dublin (H 21): *Potamopyrgus jenkinsi*, Rathgar, Dublin, M. P. KERNEY, 1952; *Agriolimax caruanae*, Monkstown Park College, Dublin R. O'CONNOR, December 1967.

Donegal West (H 35): *Arion lusitanicus*, by N. end of Lough Eske; *Pisidium conventus*, Lough Barra, 10 miles E. of Dunglow, both Dr MARY PUGH, August 1967.

The following segregates have also been determined:
Carychium minimum: 4, 12, 32, 34, 37, 55, 61, H 9, H 11, H 12.
Carychium tridentatum: 4, 26, 39, 51, 55, 61, 80.
Cochlicopa lubrica: 5, 26, 28, 32, 38, 39, 55, 61, 80, 98, 112, H 1, H 35.
Cochlicopa lubricella: 0, 10, 14, 26, 28, 38, 39, 48, 61, 96, 103, 112.
Vitrea crystallina: 4, 6, 12, 26, 27, 28, 31, 38, 39, 42, 55, 65, 70, 98.
Vitrea contracta: 6, 14, 18, 25, 26, 33, 38, 39, 55, 61, 80, 98, 106, 109, 112, H 35.
Arion ater rufus: 33.

The following records are to be deleted from the Census:
Peebles (78): delete *Oxychilus helveticus*. The Census record is based on three specimens collected by A. R. WATERSTON in 1930 at Macbie Hill, near Leadburn (Royal Scottish Museum). They were sent to me by Mr WATERSTON in 1967 and, although immature, seem not to be *O. helveticus*, but are most probably a form of *O. alliarius*. The same is true of further shells from, or near, the same place collected by D. K. KEVAN in 1934, and kindly sent by him.
Kincardine (91): delete *Oxychilus helveticus*. The specimen from Auchinblae [Auchenblae] (Royal Scottish Museum), the basis of the Census record, collected by A. R. WATERSTON in 1928 and determined as this species by J. W. TAYLOR, is a typical *Oxychilus cellarius*.

The past year has seen a number of noteworthy discoveries.

Vitrea diaphana (Studer) [recorded in last year's Report as *Vitrea subrimata* Reinhardt] has been verified from a second British locality, also in v.c. 64, and some 7 miles E. of the original station discovered in 1966 (see *J. Conch.* **26**: 288–289).

Arion lusitanicus can now be firmly recorded from Ireland, from Co. Donegal, the 70-year-old record from Castletown Berehaven, Co. Cork, remaining open to some doubt. Important new Irish finds also include *Pisidium conventus* from Lough Barra, Donegal West (the second Irish station), and *Vitrina* cf. *V. pyrenaica* from Kerry North. The specimens of the latter are unfortunately both very young, making anatomical investigation difficult, but a dissection of the rudimentary genitalia of the larger specimen by Dr LLOYD-EVANS showed that it must be referred to the group of *Semilimax* Gray (=*Vitrinopugio* Ihering), to which *V. pyrenaica* belongs. If this determination can ultimately be confirmed, it would make less likely the view that *V. pyrenaica* is an introduction into Ireland, as has sometimes been suspected.

In Sussex East *Helicella elegans* has been found in chalk grassland at several spots around Denton, near Newhaven, and seems well established there. These occurrences must represent fresh introductions from abroad, as the species seems scarcely likely to have been distributed from either of the two other very limited British colonies (Chaldon, Surrey, and Walmer, Kent East).

Since last year's announcement of the discovery of the true *Agriolimax agrestis* on the Scottish mainland, in Banffshire, Mr KELLOCK has succeeded in finding this slug in the neighbouring vice-counties of Elgin and Aberdeen North. He states that locally it is quite as common as *A. reticulatus*. It should be looked for elsewhere in Scotland.

Several new stations for rare relict species have been detected during 1967: *Acicula fusca* in Gloucester West, *Planorbis vorticulus* in Suffolk East, *Vertigo pusilla* in Gloucester East, *Truncatellina cylindrica* in Bedford, *Ena montana* in Suffolk West (this confirms several very old records, supported only by museum specimens; see *J. Conch.* **21**: 153), *Vitrina major* in Cornwall East and Hants North, and *Limax cinereoniger* in Somerset North and Lancaster West. Among the freshwater species, noteworthy extensions to known ranges are provided to *Viviparus viviparus* in Cambridge (very local throughout eastern England, where *V. contectus* to some extent replaces it), *Potamopyrgus jenkinsi* in Shetland, *Physa fontinalis* in Elgin (the most northerly known British station), *Pisidium supinum* in Norfolk West, and *Pisidium moitessierianum* in Hants North.

Among the synanthropic species, *Agriolimax caruanae* has turned up at many more places in the British Isles, usually in gardens or waste ground, and has reached the Shetlands. *Hygromia striolata* appears to be extending its range coastally in northern Scotland, colonies having been detected within the last few years in areas where it was almost certainly absent as recently as about 1930.

M. P. KERNEY

Recorder's Report: marine Mollusca

Interest in the Marine Census grows steadily. During 1967 some 200 communications were received and answered. Many Area lists, mostly following the prototype recording form presented in the *Conchologists' Newsletter* No. 17 for June 1966, have been submitted to the Recorder: the scheme singling out those records needing authentication from a particular Census Area is working very well in practice. Approximately 50 batches of specimens have been examined during the year: these have varied from a few species for authentication to many dozens of species and hundreds of specimens for checking or identification. Approximately 2,000 further records have been added to the Area and species files. Some aspects and developments of Census work are categorized below.

PUBLICITY. This remains an important aspect of the Census because there are many non-members of the Society who are able to contribute once they are aware of the Survey and their interest is stimulated. Unexpected publicity resulted from an announcement in *Underwater World* stating that information on molluscs was required by Dr M. P. KERNEY. The item had been taken from the Nature Conservancy publication *Habitat* and, in fact, referred to non-marine molluscs. Several letters were kindly forwarded by Dr KERNEY and some useful contacts have been established. Planned publicity should result from a detailed account of Census work accepted for publication in *School Projects in Natural History*, a second edition of which is being prepared by the Devon Naturalists' Trust.

SOCIETY FIELD MEETINGS. It is hoped to establish closer liaisons with leaders of future shore expeditions so that maximum help for the marine Census may result. This was put into practice most usefully on the occasion of the outing to Sandwich Bay, Kent (Census Area 13, Thames) in March 1967: records are still coming in as a consequence of return visits to the beach by members to upgrade records and seek new ones, whilst all such new records have been sent to the Recorder for authentication. A complete list showing the status of all species at present in the Census files for CA 13 is being prepared for the June issue of the *Newsletter*. The adoption of an Area or part of an Area by members can do much to hasten the build-up of information and useful moves are being made in this direction, sometimes in association with local natural history societies.

THE CENSUS FILE RECORDS. Information is often sought regarding the species already listed in the files from a particular Census Area. Obviously, extracting these from under the species headings is a time-consuming task, so a supplementary scheme is being devised. It is planned to have a series of abbreviated lists, one per Area, space being left beside the number and shortened name to indicate in the Census symbols the presence of a species and its current status, this being upgraded when warranted. In this way the Recorder can keep a reasonably up-to-date picture of each and every Area and retail the information with much reduced labour: this will also be an important step nearer the production of the first provisional Census list. Mrs H. H. NASH has kindly volunteered to undertake typing the stencils for duplicating.

VOUCHER SPECIMENS. Batches of specimens sent for inclusion in the spirit collections at the British Museum (Natural History) numbered only about 60. It is hoped that more such material will be forwarded to the Recorder in the future.

SOME SELECTED RECORDS AND THEIR SIGNIFICANCE. It is rare to find species new to the British list: it is even rarer to discover species new to science in Britain. In July 1967 Dr EDMUND H. SMITH published descriptions of two turrids found in the Clyde Sea Area (*Veliger* **10**: 1–4): dissection revealed neither salivary nor poison glands, nor the radula typical of *Philbertia*, although the shell characters of one of the species were said to be so close to those of *P. leufroyi boothii* (Smith, 1839) that confusion could have occurred. Dr SMITH describes both species in a new genus *Cenodagreutes* as *C. aethus* and *C. coccyginus*. Little seems to be known about the precise food and habits of the British conelets and in the light of this discovery it is hoped that members will collect live species or shells in unworn condition for detailed examination.

Specimens of the S. European tectibranch *Aplysia depilans* (L.), rare in British waters, were found in Census Area 21, washed up on the north coast of Devon in November 1966. One of the specimens was forwarded by Mr N. A. HOLME and later placed in the National Collections. Dr N. B. EALES has confirmed the identification and the fact that this is the first record from the Bristol Channel. Previous British records are from CA 15 (Wight), CA 16 (Portland), CA 17 (Channel

Isles) and CA 18 (West Channel). All except one, from Babbacombe, S. Devon in 1947, were found during the last century. Another nineteenth-century report of this animal is geographically very out of context: it was presented to the British Museum by Dr G. JOHNSTON from the River Tweed in CA 9. Three species of sea hare have been found in Britain, *A. punctata* (Cuvier) being quite common, whilst only one British record exists for *A. fasciata* Poiret: this was found near Salcombe, S. Devon in 1947.

Published information suggests that *Venerupis saxatilis* (Fleuriau de Bellevue) might be confined to southern and western coasts, but records submitted from CA 7 (Firth of Forth) by Dr SHELAGH M. SMITH indicate a wider distribution. This may be of some significance in considering the status of the form which FORBES & HANLEY (*History of the British Mollusca and their Shells* **1**: 383) state is connected by intermediate stages with *Venerupis pullastra* (Montagu): if the form and sculpture of the shell are indeed caused by environmental factors one would expect to find no difference in range. Mr J. CRUISE at the Fisheries Laboratory, Burnham-on-Crouch, may be undertaking some research on the larval stages of the two species and in any event would appreciate receiving records of all *Venerupis* species either direct or through the Recorder. The Ministry of Agriculture, Fisheries and Food is encouraging research on this genus in view of its past importance as food in this country.

Inevitably exotic specimens occasionally occur amongst those sent to the Recorder for an opinion (see *J. Conch.* **25**: 312 for other such records). A separate file is being kept for these aliens, but it should be pointed out that precise identification can be very difficult, if not impossible, when their native country is unknown, the soft parts are missing and the shells often worn. Recently received was a perfect example of *Divaricella* cf. *D. cumingi* Adams & Angas, native of the Indo-Pacific region. This was picked up on East Sands, Ryde, Isle of Wight, by Mr and Mrs L. C. PREBBLE in February 1964: the finders' own theory of how this and other foreign shells have come to lie on Isle of Wight shores is worth consideration. They suggest that as the big liners find their way into Cowes Roads before entering Southampton Water, people re-pack their luggage, discarding any shells dried in tropical heat and already smelling in our damp climate. In the summer of 1967, Mr P. CAMBRIDGE found some groups of exotic mussels with remains of the animals tangled in seaweed at Fairhaven on the Ribble, Lancs. These were probably *Septifer* sp. and Mr CAMBRIDGE suggests they may have come off the bottom of a ship. Exotics doubtless reach our shores in many different ways—ballast, on the bottoms of ships, tangled in Gulf weed, and so on. Keeping notes on such strays as a sideline to the Census may reveal some pattern correlated with seasons and weather in the instance of those species which are drifted from the West Indies by the Gulf Stream.

SOME ECOTYPES OF SPECIAL INTEREST. Brackish lakes, lagoons and ditches usually contain 'still water' forms of species, characterized by less sculpturing of the shell surface and more fragile shells. Notes on the salinity, depth and substrate should be noted if possible. Mr A. FEATHERSTONE sent some specimens collected live in September 1967 from the land-locked lake known as 'Abraham's Bosom' at Wells in Norfolk (CA 12): these included *Cerastoderma glaucum* (Poiret) (=*Cardium lamarckii* Reeve), *Mya arenaria* L. and small examples of *Lepidochitona cinerea* (L.). The Fleet Lagoon, Dorset (CA 16), is another similar site from which live records would be welcomed: in April 1967 Dr PEIGI WALLACE collected a number of empty shells from shore drift. Species included approximately 50 of the smooth, produced form of *Littorina saxatilis tenebrosa* (Montagu)—as this possible subspecies is understood by JEFFREYS; 150 of the ribless *Rissoa membranacea membranacea* (J. Adams); 100 *Cerastoderma glaucum*; 200 *Akera bullata* Müller which were probably juveniles, but may possibly have been the var. *nana* of Jeffreys; 20 *Abra tenuis* (Montagu) and *Hydrobia ventrosa* (Montagu).

It cannot be emphasized too strongly or too often that the object of the Marine Census Survey is not to single out the rarities for special attention, but to build up our knowledge of the geographical range and ecological preferences shown by living populations of all species, including the very common ones. The presence of empty shells although of secondary significance can still further this primary object.

General thanks are given to all those who have helped the Recorder in various ways.

STELLA M. TURK

Report on Junior Membership

During the year 7 new members have been elected, 3 have resigned and 2 have transferred to full membership in the Society; the total now stands at 29.

Two numbers of *Papers for Students* have been published, No. 8 'Dissecting Snails', by Mr M. R. Block, B.SC., and No. 9 'The Identification of British Chitons' by Mrs Gillian Matthews, M.SC., PH.D. The former was well reviewed in *Education in Science* in November and as an immediate result 61 copies were sold. These have been purchased mostly by Colleges of Education, Grammar Schools and Local Education Authorities. The total sales for this paper in the period reported on is 125 copies.

Of previously published papers, 131 copies have been sold in the same period and the total amount recovered by the Society for its original outlay on the papers is about £30.

A large exhibit on Mollusca has been set up in The Priory, Orpington, which has been on show for five months. Here the work of the two Censuses is illustrated and Junior Membership emphasized.

H. E. J. Biggs

Curator's Report

Following the trend of previous years, most new additions to the Voucher Collection during 1967 were spirit specimens of slugs, which consisted largely of species of the genera *Arion* and *Agriolimax*. Once again we are grateful to the active group of members for making these specimens generally available, and to Mr A. E. Ellis for dissecting many of the slugs.

June E. Chatfield

Field Meetings

Seven field meetings were held during 1967 as follows: 11 March, Sandwich, Kent; 6 May, Leicester; 22 July, West Runton, Norfolk; 30 July, Lewes, Sussex; 16 September, Northampton; 29 September–1 October, Bristol; 22 October, Basingstoke, Hants. Two weekend meetings arranged to the Isle of Wight and Ipswich, Suffolk, were cancelled due to lack of support.

Nine meetings organized by our Lancashire and Cheshire members were held during the period: 14 January, Cotterill Clough; 25 February, Southport, Lancs.; 11 March, Cotterill Clough; 23 March, Southport; 18 June, Heysham Flash; 22 July, Witton Lime Beds; 12 August, Tawd Vale Woods; 9 September, Chipping, Lancs.; 28 October, Southport. A meeting arranged for November was cancelled because of the foot-and-mouth epidemic.

The Society's Yorkshire branch held three meetings, as under: April, Ryhill; May, Tadcaster; September, Wentbridge and district.

Thanks are due to the following for leading these meetings: Messrs R. Fresco-Corbu, I. M. Evans, R. A. D. Markham, D. G. Pickrell, A. Gee, G. Whitfield, E. F. Greenwood, A. Lord, P. J. Askey, L. Harefield, E. Thompson, J. Summerton, S. Appleyard, Dr M. P. Kerney, Miss J. E. Chatfield, Mrs P. List, Mrs M. Fogan and Mrs N. F. McMillan.

Reports on many of these meetings are published in the Society's Newsletter.

T. Pain

Votes of Thanks

Votes of thanks were approved to the Trustees of the British Museum (Natural History) for the continued use of the Board Room, and to the Officers and Council of the Society.

Presidential Address

The President delivered an address entitled 'Le fanatisme du *nobis*: a study of J. R. Bourguignat and the "nouvelle école" '.

Election of Officers and Council

The Officers and Council were declared elected, as shown on p. 299.

CHANGES OF ADDRESS

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CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

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2. Manuscripts should be typed (double-spaced) on one side of the paper, leaving ample margins, and the folios numbered consecutively. Titles should be concise, and the address(es) of the author(s) indicated. Scientific names of genera and species should be underlined, authorities for specific names should be given at their first occurrence in the text. All linear measurements and weights should be in the metric system.

3. Manuscripts must be submitted in finalized, fully revised and corrected form; proof corrections are expensive and should be restricted to typographical errors. All corrections in excess of this are liable to be charged to the author. It is a function of the Editor to maintain a standard of uniformity in the presentation of papers published in the *Journal*, and authors who submit papers implicitly acqinesce in his discretion in such matters; they are recommended to study the arrangement and conventions observed in the current number. Authors should retain a carbon copy of the manuscript.

4. Text-figures must be drawn in black Indian ink, preferably on Bristol board, and numbered consecutively in arabic figures. Figures are referred to in the text as 'Fig. 1', etc.; where there is also a plate containing several figures, figures in the text are referred to as 'Text-fig. 1', etc. Lettering may be left to the Editor, in which case the information should be lightly inserted in pencil. The position of text-figures, graphs and tables should be indicated in the margin of the text. Legends for figures must be typed on a separate sheet and not on the actual illustration.

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Mollusks

Vol. 26 JULY 1971 No. 6

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CONTENTS

PAGE
NORA F. MCMILLAN—Large *Cardium edule* L. and *Mytilus edulis* L. . 353
S. PETER DANCE—The Cook Voyages and Conchology . . 354
G. E. BEEDHAM—The extrapallial cavity in *Anodonta cygnea* (L.) inhabited by an insect larva 380
G. A. S. BARNACLE—Note on a Streptaxid from Seychelles *Imperturbatia levieuxi* (Nevill & Nevill) 386
M. R. BLOCK—Epiphragms: some observations . . . 388
A. J. CAIN—Undescribed polymorphisms in two British snails. . 410
B. VERDCOURT—*Physa* in East Africa 417
Obituaries: Herbert Leader Hawkins, F.R.S., 1887–1968; Douglas Keely Kevan, 1895–1968; Douglas Panton Blair, 1883–1968 . . 418
Reviews 422
Proceedings: Members Elected 425
Index to Volume 26 427
PLATE 16

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LARGE *CARDIUM EDULE* L. AND *MYTILUS EDULIS* L.

NORA F. MCMILLAN
The Nook, Uplands Road, Bromborough, Cheshire
(*Read before the Society*, 15 *May* 1971)

Winckworth (1921) recorded a giant race of *Cardium edule* L., measuring up to 76 by 64 mm, from Congesquoy, near Stromness in Orkney, and later Mr Kellock (Heppell 1966) took a few equally large examples in Scapa Bay, also in Orkney.

Some shore-collecting at Melsetter, at the head of Longhope, Orkney in 1967 produced numerous large specimens of *Cardium edule* (all dead) which while not as large as those from Congesquoy and Scapa Bay are nevertheless quite creditable. Twelve measured specimens averaged 45 mm in height and 54 mm in length; Winckworth's specimens averaged 'about 60 mm across', the same as Jeffreys' (1863, p. 289) largest specimens from Unst (Shetland) and Stornaway (Outer Hebrides).

Melsetter is at the head of the fine inlet of Longhope, on the west side of Scapa Flow; it almost separates the island of Hoy from its lesser neighbour Walls. Conditions are sheltered but wholly marine.

Melsetter also yielded fine large valves of *Mytilus edulis* L. up to 90 by 46 mm; eight valves averaged a shade under 80 mm. However, larger specimens of *M. edulis* were taken in Shetland in July 1969. These were abundant on the timbers of an old pier which had been demolished at Walls (on Mainland), and the average size was 100 mm or a little more. The shells were encrusted with the barnacles *Balanus balanus* (L.) and *B. crenatus* Brug. (det. J. Roskell).

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J. Conch. **26**: 354–379. (1971)

THE COOK VOYAGES AND CONCHOLOGY

S. PETER DANCE
Zoology Department, National Museum of Wales, Cardiff

(*Presidential Address, delivered* 18 *February* 1967)

CONTENTS

BACKGROUND TO THE COOK VOYAGES p. 354
THE FIRST VOYAGE, 1768–71 358
THE SECOND VOYAGE, 1772–75 360
THE THIRD VOYAGE, 1776–80 361
FIELD OBSERVATIONS ON MOLLUSCS 361
DISPERSAL OF THE COLLECTED MATERIAL 366
CONTEMPORARY LITERATURE 370
MOLLUSCS COLLECTED DURING COOK'S VOYAGES 372
ACKNOWLEDGMENTS 377
REFERENCES 377

BACKGROUND TO THE COOK VOYAGES

Two hundred years ago about 800 molluscan species were known to science. CARL LINNAEUS (1707–78) had named and described them all in the twelfth edition of his *Systema Naturae* (LINNAEUS, 1767); and specimens of most of them were in his own collection or in that of the Queen of Sweden, LOUISA ULRICA (1720–82). A few years before he died, however, it had become obvious to him that many more existed; and had he lived to produce a further edition of the *Systema*, many of the additional species would have been recorded by him. It is likely that most of the species collected by the men who sailed around the world with JAMES COOK (1728–79) would have found a place in his projected thirteenth edition.

When COOK was killed there were others willing and able to carry on his pioneering work. When LINNAEUS died several were willing but none able to continue in his footsteps. Consequently, while mariners were completing the survey of the Pacific, many of the countless new animals and plants collected in that ocean by COOK's men remained unnamed, undescribed and unillustrated. The exotic shells they found became popular playthings of affluent collectors few of whom were competent conchologists; and were it not for the illustrations published by one or two of them we should now have a very imperfect idea of the contribution to conchology made by the men who sailed with COOK.

Exotic, in those days, usually implied that the object originated from the East or West Indies; never, as it might today, from the central Pacific. It was from Dutch and French possessions overseas that such objects came; seldom, as they did later, from British. The exotic shells in the museum of LOUISA ULRICA were garnered in the marts of Amsterdam and Paris; never, as they would have been in later years, in those of London. The animals and plants of the Pacific were almost completely unknown to LINNAEUS; and he was an old, tired man when the novelties of the first of COOK's voyages reached Europe. Infirm though he was, he pleaded for material and written evidence of the natural wealth of the great 'South Sea'; but his pleas were ignored. Had he been younger, his friends more co-operative, how different had been the outcome of one of the more important aspects of those voyages!

Knowledge of Pacific geography in 1768 was fragmentary. A glance at ROBERT DE VAUGONDY's map, published in 1756 and one of the best available to COOK (Fig. 1), illustrates this better than words. [The copy of this map utilized by COOK is reproduced by CARRINGTON (1939).] Australia's east coast is merely guessed at; a hesitant squiggle passes for New Zealand; and the Solomon Islands are shown a thousand miles east of their true position. Pointless to look for Tahiti, discovered byWALLIS in 1767; and COOK himself was to discover New Caledonia and Hawaii. Is it so surprising then that man's knowledge of Pacific natural history was just as fragmentary? A few shells, being durable objects easily collected, might have been present in one or two collections but none of them could have been collected on Australia's east coast, or on the coasts of New Zealand, New Caledonia, Hawaii, or the islands of Polynesia.

Of course COOK had his precursors in the Pacific; many brave men had sailed that ocean before him: MAGELLAN—the first and possibly the bravest—followed by MENDAÑA and QUIROS, DRAKE and CAVENDISH, and after them a succession of Dutchmen, Englishmen, Spaniards and Frenchmen. All of them enlarged our knowledge of Pacific geography; only one (if we except the erratic contributions of WILLIAM DAMPIER (1651–1715) added significantly to our knowledge of its natural history: LOUIS ANTOINE DE BOUGAINVILLE (1729–1811), who entered the Pacific a few months before COOK and who had on board the botanist PHILIBERT COMMERSON (1727–73).*

It is unnecessary to explain in detail the purposes of the first of COOK's voyages; that has been done fully, and often, and by none better than J. C.

---

* VITUS BERING (1680–1741) and GEORG WILHELM STELLER (1709–46) deserve honourable mention here. BERING's expeditions to north Asia (1737), Kamchatka (1740–41, 1742–44) and to the coast of Alaska and Bering Island (1741–42) resulted in important geographical discoveries; and STELLER, who was the first man to be officially appointed as naturalist to accompany an expedition to the Pacific, was probably the most competent observer of Pacific natural history in the eighteenth century.

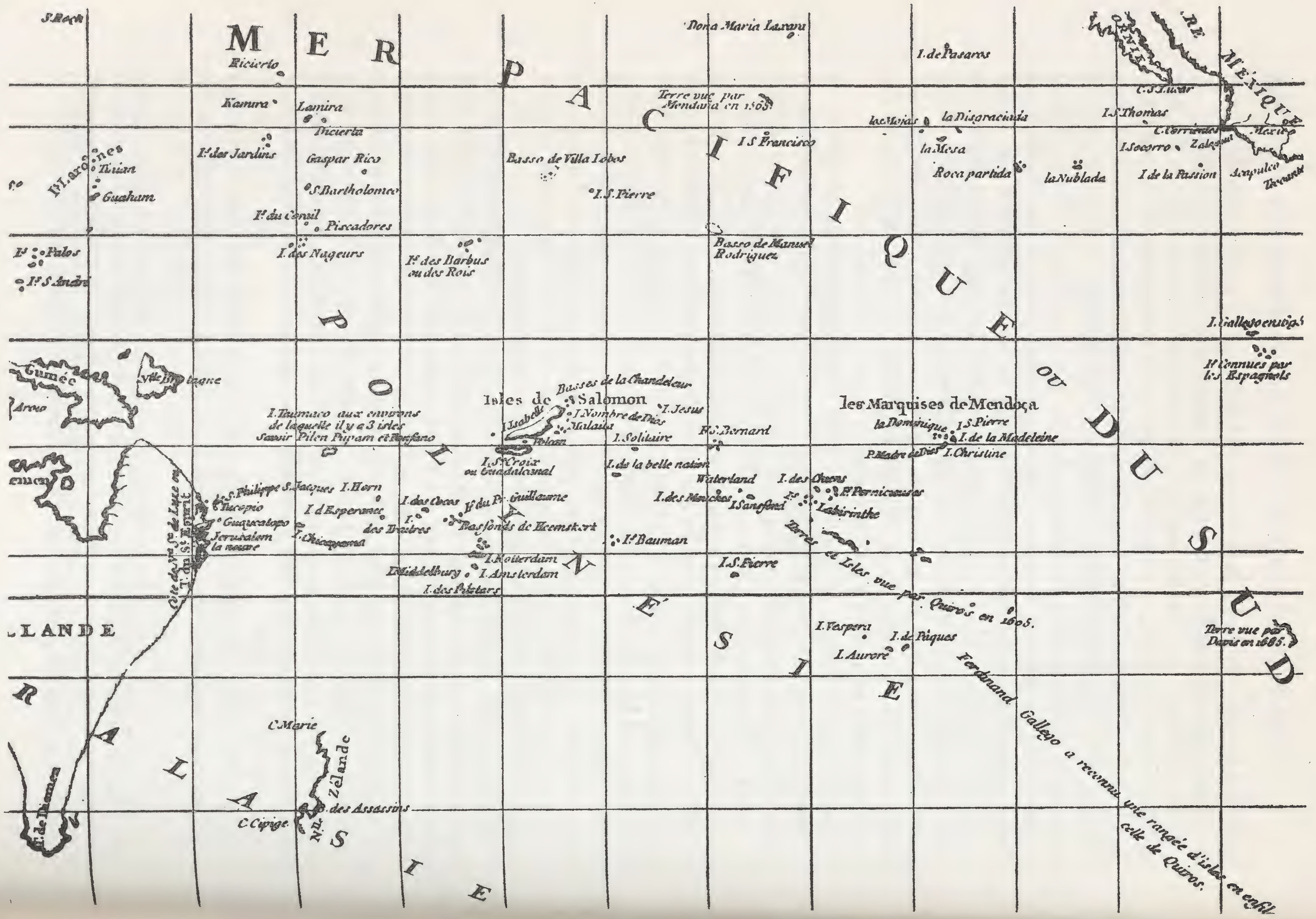

Fig. 1. Part of Robert de Vaugondy's map of the Pacific (1756)

BEAGLEHOLE in numerous publications. Stated briefly, it had three objectives: *a*—to observe the transit of Venus over the sun in 1768; *b*—to find, if indeed it existed, 'Terra Australis Incognita', that enormous southern continent, the darling of arm-chair geographers, long supposed to occupy the larger part of the southern hemisphere; *c*—to fix the exact positions of newly discovered islands, to annex those deemed important, and to watch out for new discoveries. Initially, therefore, the voyage was to further discoveries in geography and astronomy. But on 9 June 1768, less than three months before COOK's ship 'Endeavour' left Plymouth, the secretary to the Royal Society entered the following passage in the Minutes of the Council: 'Joseph Banks Esqr Fellow of this Society, a Gentleman of large fortune, who is well versed in natural history, being Desirous of undertaking the same voyage the Council very earnestly request their Lordships [i.e. the Admiralty], that in regard to Mr Banks's great personal merit, and for the Advancement of useful knowledge, He also, together with his Suite, being seven persons more, that is, eight persons in all, together with their baggage, be received on board of the Ship, under the command of Captain Cook' (BEAGLEHOLE, 1962 **I**: 22).

About JOSEPH BANKS (1743–1820), one of the most influential and versatile Englishmen of his generation, a great deal has been written; perhaps the best account is that of BEAGLEHOLE (1962). To BANKS, even more than to COOK, our attention will be drawn in the following pages. The Admiralty agreed to let him and his suite join the 'Endeavour', and COOK had to find extra accommodation in his already overcrowded ship. The voyage now had a fourth objective—to study the natural history of the places visited. BANKS had some knowledge of botany and zoology, and the artists he brought along were more than capable of drawing animals, plants and scenery. But he has brought along someone far more useful, someone whose reputation as a naturalist was very high: DANIEL CARL SOLANDER (1733–82), a former pupil of LINNAEUS. Easily the better naturalist of the two, SOLANDER has received less biographical attention than BANKS; and as he did not keep a journal during the voyage (at least none is known) his observations are lost to us.

The voyage is well documented. COOK and BANKS kept very full journals and both have been published in their entirety (BEAGLEHOLE, 1955; 1962); and much additional information on the voyage has been published by others in recent years. Original drawings of plants, animals and scenery are preserved in the British Museum (Antiquities), the British Museum (Natural History) and elsewhere. Accounts of the ethnological, botanical and zoological results have been published, but the only detailed study from a conchological standpoint is that of WILKINS (1955).

THE FIRST VOYAGE, 1768–71

SUMMARY OF ITINERARY (after GROVES, 1962): 20 August 1768, 'Endeavour' leaves Plymouth; stops a few days at Madeira; crosses Atlantic to Rio de Janeiro; south to Bay of Good Success [= Buen Suceso], Tierra del Fuego; January 1769 enters Pacific; 13 April, reaches Tahiti; 1 June, leaves Tahiti and cruises among Society Islands; 9 August, sails for New Zealand; October, reaches Poverty Bay; 31 March 1770, completes circumnavigation of New Zealand and sails for unexplored east coast of Australia; 29 April, reaches Botany Bay; sails north and through Barrier Reef; 3 September, at Cook's Bay, New Guinea; calls at Lesser Sunda Islands, on west coast of Java, and at one of the Agenieten group; 11 October, reaches Batavia [=Djakarta]; 26 December, leaves Batavia; January 1771, Prince's Island off west Java; 15 March–15 April, at Cape of Good Hope; 1–4 May, at St Helena; 13 July 1771, 'Endeavour' arrives at Deal, Kent.

The voyage, marred only by a number of deaths resulting principally from tertian malaria contracted at Batavia, had been an outstanding success. In the history of maritime exploration it could be ranked equal to those of COLUMBUS, MAGELLAN and TASMAN; it eclipsed that of BOUGAINVILLE. As an example of inspired navigation it was not excelled until COOK completed his second circumnavigation. He had hardly stretched his long legs on land before he was promoted commander and placed in charge of another expedition. The principal objective of this one was to try to end speculation over the 'Great Southern Continent', the first voyage having been indecisive in this respect.

BANKS wanted to accompany COOK again; SOLANDER too. There were misunderstandings, however, and COOK eventually sailed without them. Meanwhile news had reached LINNAEUS in Uppsala that BANKS and SOLANDER were intending to sail around the world once more. Greatly agitated, he wrote to JOHN ELLIS (1711–76) on 22 October 1771: 'I have just read, in some foreign newspaper, that our friend Solander intends to revisit those new countries discovered by Mr. Banks and himself, in the ensuing spring. This report has affected me so much as almost entirely to deprive me of sleep. How vain are the hopes of man. Whilst the whole botanical world, like myself, has been looking for the most transcendent benefits to our science from the unrivalled exertions of your countrymen, all their matchless and truly astonishing collection, such as has never been seen before, nor may ever be seen again, is to be put aside untouched, to be thrust into some corner, to become perhaps the prey of insects and of destruction. . . . By all that is great and good, I entreat you, who know so well the value of science, to do all that in you lies for the publication of these new acquisitions, that the learned world may not be deprived of them. They will afford a fresh proof that the English nation promotes science more than the French, or all other people together. . . . When I ponder upon the insects they have brought, I am overwhelmed at the reported number of new species. . . . When I think of their *mollusca*,* I conceive the new ones must be very numerous. . . . Do but consider, my friend, if these treasures are kept back, what may happen to them: they may be devoured by vermin of all kinds. The house where they are lodged may be burnt.† Those destined to describe them may die . . . I therefore once more beg, nay, I earnestly beseech you, to urge the publication of these new discoveries . . .' (MAIDEN, 1909: 81–82). ELLIS replied on 19 November 1771: 'I received both your kind letters of the 8th of August, and the 22nd of October, from Upsal. I delivered the two letters inclosed in that of the 8th of August, to Mr. Banks and Dr. Solander, and they both promised me that they would write to you; but they have been so hurried with company that they have very little time. They are now at Oxford, where they went to receive the honorary degrees of Doctors, and are soon expected in town, when I shall lay your last letter before them' (MAIDEN, 1909: 83). But LINNAEUS pleaded in vain.

BANKS and SOLANDER did not go with COOK again; instead, in 1772, they went to Iceland. Soon they were back home, content to sail into the calmer, more agreeable waters of fashionable society. Once the whole of the Pacific had not been able to contain their curiosity: now London sufficed. Once they marvelled at the beauty and variety of nature in the world's largest ocean: now London was coming to marvel at them—and they were loving it. In one respect LINNAEUS's death was timely: he was spared the frustration of waiting for the great works which never materialized; they, the humiliation of the great man breathing down their necks, prodding their consciences.

Two men of quite different character were chosen to accompany COOK as naturalists: the Germans JOHANN REINHOLD FORSTER (1729–98) and his son JOHANN GEORG ADAM FORSTER (1754–94). The elder FORSTER proved to be an unfortunate choice as he grumbled throughout the voyage and was heartily disliked by the entire crew. The son, a naturally pleasant youth, was under his father's influence the whole time. Personalities apart, they did much more to advance our knowledge of Pacific natural history than did BANKS and SOLANDER. Mindful of his experiences on the east coast of Australia (the ship had foundered on a reef and disaster had been narrowly averted), COOK was convinced that a consort was desirable on such lengthy voyages and two ships were now made available to him: the 'Resolution', to be under his command, and the 'Adventure', under that of the unadventurous TOBIAS FURNEAUX (1735–81).

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* Not Mollusca in the modern sense; in the *Systema* LINNAEUS places in 'Vermes Mollusca' all soft-bodied animals, such as slugs, nudibranchs, leeches, holothurians and cephalopods. Molluscs with external shells were placed in his 'Vermes Testacea'.

† LINNAEUS here speaks from personal experience. His own collections had been endangered by fire in 1766; and subsequently they were damaged by damp and the depredations of mice and insects (DANCE, 1967: 2).

THE SECOND VOYAGE, 1772–75

SUMMARY OF ITINERARY: 13 July 1772, 'Resolution' and 'Adventure' leave Plymouth together; Madeira reached before the end of that month; 30 October, Cape of Good Hope; 22 November, south towards Antarctica; 17 January 1773, Antarctic Circle crossed in a latitude of almost 67° S.; ships retreat before an immense ice-field; sail to the north-west; 8 February, ships part during a gale; 'Resolution' makes for New Zealand; 26 March, 'Resolution' in Dusky Sound; 18 May, finds 'Adventure' in Queen Charlotte's Sound ('Adventure' had been to Tasmania in the interval); both ships make for Tahiti via Tuamotu group; middle of August, reach Tahiti; islands in the Society group visited (including Huahine where the 'Adventure' picks up OMAI, a young native who returned in the ship to England); islands in the Cook and Society groups visited before ships sail again for New Zealand; middle of October, ships part again shortly after arriving off Poverty Bay; 'Resolution' probes southwards; 31 January 1774, 'Resolution' reaches latitude 71° 10′ S., well south of present Graham Land's northern extremity, where ice forces ship north; middle of March, at Easter Island; makes for Tahiti; Marquesas re-discovered; group of atolls discovered; 22 April, Matavai Bay, Tahiti; 14 May, leaves Tahiti; explores New Hebrides, continues southwards and discovers New Caledonia; Isle of Pines and Norfolk Island discovered; 17 October, Queen Charlotte's Sound again; 11 November, leaves there for final leg of voyage, via Cape Horn, to South Georgia and Sandwich group, reaching a latitude of almost 60° S.; 21 March 1775, at Cape of Good Hope; five weeks later, sails for home, calling at St Helena, Ascension and the Azores; 29 July 1775, anchors at Spithead.

By any standards this was a remarkable voyage. Never again would 'Terra Australis Incognita' trouble geographers and seamen—COOK had often sailed through its supposed boundaries—and for the first time scurvy had been defeated decisively. The discovery of New Caledonia and some lesser islands, and the re-discovery of the Marquesas—lost ever since MENDAÑA first stumbled on them in 1595—and of several other islands poorly charted previously, were among the numerous fringe benefits. The wanderings of the 'Adventure' after the second parting were less notable. Leaving New Zealand on 23 December 1773, minus a boatload of men massacred by Maoris, FURNEAUX made for Cape Horn; thence he sailed into high latitudes to the Cape of Good Hope, and he arrived home 14 July 1774—a year ahead of COOK.

Two circumstances combined to make a third voyage desirable: OMAI had to be returned to Huahine; and the Admiralty wanted to settle the baffling question of the North West Passage. COOK, inevitably (and unwisely as it turned out), was chosen as leader yet again. The 'Resolution' was to be pressed into service once more, and she was to be accompanied by the 'Discovery', commanded by

Charles Clerke (1741–79). The naturalist on this voyage was to be William Anderson (1748–78). None of these three was destined to return home.

The Third Voyage, 1776–80

Summary of Itinerary: 12 July 1776, 'Resolution' leaves Plymouth ('Discovery' leaves in August); 18 October, 'Resolution' at Table Bay, Cape of Good Hope (10 November, joined there by 'Discovery', both ships together for remainder of voyage); proceed, past Marion and Crozet Islands, to Kerguelen; Adventure Bay, Tasmania; 12 February 1777, Queen Charlotte's Sound, New Zealand; north to Cook group and Tonga; 12 August–29 September, Tahiti; Huahine, Raiatea (one month's stay); 24 December, Christmas Island; 18 January 1778, Hawaiian Islands; 2 February, leave for coast of North America; 7 March, Oregon coast sighted; north to Alaska, King George's (or Nootka) Sound, Cook Inlet, through Bering Strait, to latitude 70° 44′ N.; south-west to coast of Asia and back to Norton Sound, Alaska; Unalaska; 26 October, leave Unalaska; late November, in Hawaiian Islands; 11 February 1779, leave Kealakekua Bay but forced to return for repairs; 14 February, Cook killed at Kealakekua Bay; 23 April, sail north with Clerke in command; through Bering Strait but ice and fog bar further progress; 22 August, Clerke dies, John Gore in command of 'Resolution', James King in command of 'Discovery'; to Petropavlovsk, leave there 9 October; 4 December, reach Macao; six months later, Cape of Good Hope; 4 October 1780, both ships anchor off the Nore.

The three voyages spanned a dozen years; they opened up the Pacific and revolutionized existing maps of it (Fig. 2); and they showed what could be done by courageous men aided by precise instruments. Opportunities for nature study were almost limitless; there were competent naturalists aboard all the time; and large collections of natural objects were made. The observations on molluscs and the nature and ultimate fate of the shells collected during the voyages are discussed below. As some of the following statements reflect unfavourably on some of the participants it should be borne in mind that other aspects of natural history interested them more. A wider appraisal of their natural-history activities would certainly justify conclusions less harsh. While this paper was in press an important study of the zoological specimens of the Cook voyages was published (Whitehead, 1969). It concludes that the dispersal and neglect of the animal specimens 'was principally due to Banks's mainly botanical leanings, Solander's early death and the perhaps deservedly low standing of the British Museum at that time'.

Field Observations on Molluscs

Conchology was not the first love of any of the naturalists who sailed with

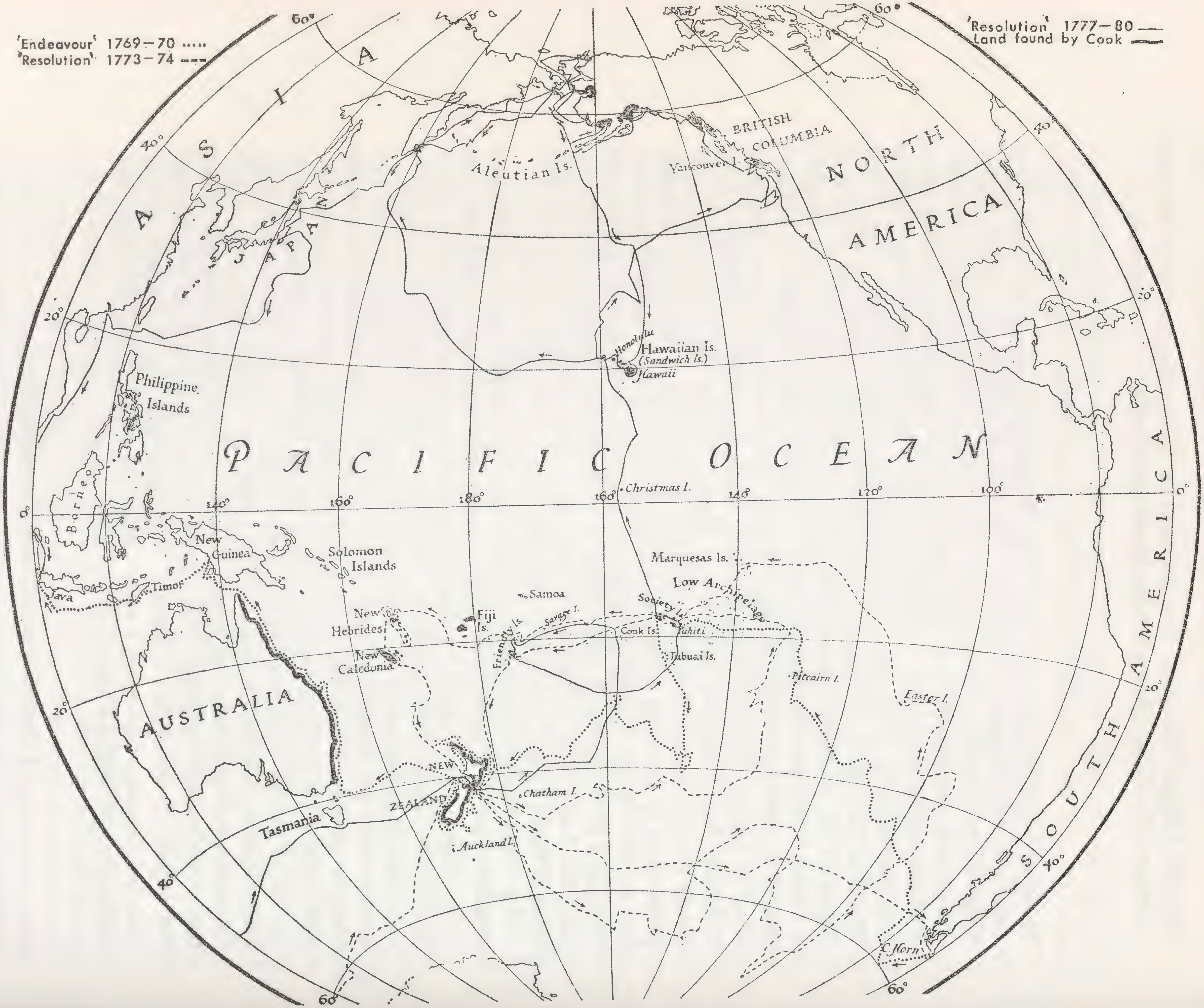

Fig. 2. Map of the Pacific showing the itineraries and discoveries of Captain James Cook (reproduced by kind permission of the Royal Geographical Society).

COOK. Consequently, there are few references to molluscs in their journals and other writings. BANKS's journal is frugal in this respect, and molluscs are all but ignored by others. Once or twice BANKS made excursions to collect shells. On 30 January 1770, when on the south side of Cook Strait, New Zealand, he wrote: 'I myself out gathering Shells in which I had some success' (BEAGLEHOLE, 1962 **I**: 461); and on 30 April 1770, when at Botany Bay: 'Myself in the Even landed on a small Island on the Northern side of the bay to search for Shells' (BEAGLEHOLE, 1962 **II**: 56). But such excursions were rare and usually they were made with the intention of getting something to eat, such as oysters.

Frequently, when the 'Endeavour' was out of sight of land, BANKS would go out in one of the ship's boats to scoop up marine organisms; in this way he captured several pelagic and planktonic molluscs. On 7 October 1768, well out in the Atlantic, he netted an assortment of creatures including living specimens of *Janthina janthina* (L.) and *J. globosa* (Swainson). These received close attention in his journal: 'They are found floating on the top of the water by means of a small cluster of Bubbles filld with air, which are composed of a tenacious slimey substance, not easily parting with its contents; these keep him suspended on the surface of the water and serve as a hiding for his Eggs, and it is probable that he never goes to the bottom, or willingly comes near any shore, as his shell is of so brittle construction that few fresh water snails are so thin. Every shell contains within it about a teaspoonful of Liquid, which it easily discharges on being touched, this is of a most beautiful red purple colour and easily dies linnen clothes; it may be well worth inquiry whether or not this is the *purpura* of the ancients as the shell is certainly found in the Mediterranean. We have not yet taken a sufficient quantity of the Shells to try the experiment, probably we shall do so soon' (BEAGLEHOLE, 1962 **I**: 171).* [The official historian of the first voyage borrowed BANKS's journal and published this account of *Janthina* in abbreviated form (HAWKESWORTH, 1773 **II**: 14).]

Shortly afterwards, on 29 October 1768, a pteropod which he called merely '*Clio*' was taken (BEAGLEHOLE, 1962 **I**: 180). On several occasions he found specimens of a beautiful little nudibranch to which he gave the name '*Mimus volutator*' (BEAGLEHOLE, 1962 **I**: 170, 238; **II**: 45, 51). GEORG FORSTER, in the journal he kept during the second voyage, recorded the capture of the same creature on at least two occasions. On 8 September 1772, when crossing the equator north of Ascension Island, he caught 'a new genus of Mollusca & called it . . . *Glaucus atlanticus*' (FORSTER, 1772: 22); and in 1777 he published a description of it under that name (FORSTER, 1777 **I**: 49).† On 30 October 1768, BANKS recorded finding a '*Clio*' amongst a small collection of animals netted in mid-Atlantic the night before (BEAGLEHOLE, 1962 I: 180); and FORSTER recorded the capture of 'several specimens of a *Clio*' on 12 October 1772 when in the Atlantic to the west of the Cape of Good Hope (FORSTER, 1772: 30). Though certainly pteropods in each instance, their specific identity cannot be ascertained.

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* The use of *Janthina* in the manufacture of royal purple should not be ruled out. On the other hand prodigious numbers of these snails would have been necessary to obtain a sufficient quantity of liquid to dye even a small piece of cloth.

† BABA (1949), ABBOTT (1954) and others have called this species '*Glaucus marinus* (Dupont)'. This, however, is a cheironym. Although DUPONT (1763) described and figured this species, he did not give it a name. The specific name 'marinus' is pre-Linnaean and thus invalid.

On 3 March 1769, a month after the 'Endeavour' had entered the Pacific, BANKS noted the capture of a much larger creature: 'I found . . . this day a large *Sepia* cuttle fish laying on the water just dead but so pulld to pieces by the birds that his Species could not be determined; only this I know that of him was made one of the best soups I ever eat. He was very large, differed from the Europaeans in that his arms instead of being (like them) furnished with suckers were armed with a double row of very sharp talons, resembling in shape those of a cat and like them retractable into a sheath of skin from whence they might be thrust at pleasure' (BEAGLEHOLE, 1962 I: 236). Fortunately, some pieces of the animal were saved and many years later were studied by RICHARD OWEN. He concluded that the animal belonged to a previously undescribed species which he named *Enoploteuthis cookii* (OWEN, 1881)—now considered synonymous with *Cucioteuthis molinae* (d'Orbigny); a well-preserved section through its beak is in the Hunterian Museum of the Royal College of Surgeons, London. On 23 May 1770, SYDNEY PARKINSON, one of BANKS's artists, recorded the discovery of another, more familiar cephalopod, *Nautilus pompilius* L., 'and some of a curious kind of hammer oysters' [*Malleus* sp.] (PARKINSON, 1773: 138); the 'Endeavour' was then off Bustard Bay, Queensland.

Notes on shore and reef collecting are disappointingly few and are nearly all contained in BANKS's journal; we have scarcely any information for the second and third voyages. At the Bay of Good Success, Tierra del Fuego, BANKS and SOLANDER decided to go ashore: 'spent our time very much to our satisfaction in collecting shells and plants. Of the former we found some very scarce and fine particularly limpits of several species: of these we observed as well as the shortness of our time would permit that the limpit with the longish hole at the top of his shell is inhabited by an animal very different from those which have no such holes. Here were also some fine whelks, one particularly with a long tooth . . .' (BEAGLEHOLE, 1962 I: 223). The 'limpit' was *Fissurella picta* Lamarck; its tufted mantle margins and apical hole contrast strikingly with the untufted animals and imperforate shells of *Patella* which the two observers must have seen elsewhere. The 'toothed whelk' was *Acanthina monodon* (Pallas).

Apart from commenting on the New Zealanders' use of *Haliotis* as bait on fishing nets and the edibility of one or two New Zealand bivalves, BANKS did not pay any further attention to molluscs until the 'Endeavour' was working up the east coast of Australia; and there too his interest in them was mainly gastronomical. He explored the mud banks under the mangrove trees at Bustard Bay on 23 May 1770 and found 'innumerable Oysters, Hammer oysters and many more sorts among which were a large proportion of small Pearl oysters. Whither the sea in deeper water might abound with as great a proportion of full grown ones we had not an opportunity to examine, but if it did a pearl fishery here must turn out to immense advantage' (BEAGLEHOLE, 1962 **II**: 67). The Hammer Oysters were specimens of *Malleus albus* (L.), the T-shaped bivalve so coveted by eighteenth-century collectors. The Pearl Oysters were almost certainly specimens of *Pinctada albina* (Lamarck); one of them is illustrated (under the name *Pinctada reeveana* (Dunker)) by WILKINS (1955: pl. 16, fig. 14). BANKS, always alert to the economic potentialities of natural products, would have been pleased to know that some of the world's most important pearl fisheries were to be established at Darwin, Broome and other places further north where larger and more valuable species of *Pinctada* occur.

On the night of 10 June 1770 the 'Endeavour' stuck fast on that part of the Barrier Reef which now bears its name. Not until 18 June was she brought safely to land within the entrance of the Endeavour River, on the south side of what is now Cook Harbour, the site of the modern Cooktown; she remained there until 10 July. 'During the time we stayed here', said PARKINSON, 'we picked up a great many natural curiosities from the reef we struck upon, consisting of a variety of curious shells, most of which were entirely new to Mr. Banks and Dr. Solander' (PARKINSON, 1773: 144). Many shells were collected during this period but regrettably little is recorded in the available journals. Of one mollusc, however, BANKS and others had plenty to say: the Giant Clam. On 3 July, the ship's pinnace landed on a dry reef where was found 'vast plenty of shell fish so that the Boat was completely loaded, chiefly with a large kind of Cockles (*Chama Gigas*) one of which was more than 2 men could eat. Many indeed were larger; the Cockswain of the Boat a little man declard that he saw on the reef, a dead shell of one so large that he got into it and it fairly held him' (BEAGLEHOLE, 1962 **II**: 87–88). The dead shell must have been a valve of the true Giant Clam, *Tridacna gigas* (L.); those brought back in the pinnace may have been young specimens of it, but the Endeavour Reef is within the known range of four other *Tridacna* species (ROSEWATER, 1965) so that their identity is uncertain. On 17 August, while the 'Endeavour' was anchored near Providential Channel, the reefs were searched for anything edible; but the search realized 'only 300 lb of Great Cockles, some were however of an immense size' (BEAGLEHOLE, 1962 **II**: 108). Later on, in a general account of New South Wales, BANKS recorded that 'all the shoals that were dry at half Ebb afforded . . . a profusion of Large shell fish (*Chama Gigas*). . . . The large ones of this kind had 10 or 15 lb of meat in them; it was indeed rather strong but I believe a very wholesome food and well relished by the people in general' (BEAGLEHOLE, 1962 **II**: 122).

During the third voyage, WILLIAM ANDERSON paid little attention to molluscs, but in his account of the Tonga group he commented on those found at Tongatabu: 'The many reefs and sholes on the N side of the island afford shelter for an endless variety of shell fish, amongst which are many that are esteem'd precious in Europe, such as the true Hammer oyster [*Malleus malleus* (L.)] of which however none could be obtain'd entire, a large indentated oyster [? *Pycnodonte hyotis* (L.)] & several others but none of the common sort, Panamas [*Oliva* spp.], Cones, a sort of the gigantic cockles [*Tridacna* sp.] found in the East Indies, pearl oysters and many others, several of which I believe have been hitherto unknown to the most scrupulous enquirers after that branch of Natural History' (Beaglehole, 1967 **II**: 924–925).

During the short stay at St Helena Banks collected plants and gave a brief account of what he saw there: 'Insects there are . . . a few, and one species of Snails who inhabit only the tops of the Highest ridges and probably have been there ever since their original creation . . . I feel more wonder in the finding of a little snail on the top of the Ridges of St Helena than in finding people upon America or any other part of the Globe' (Beaglehole, 1962 **II**: 269). It is impossible to identify this snail with certainty but only one species is likely to have caught his attention on the high ridges: *Chilonopsis nonpareil* (Perry), the largest (though probably not appearing large to Banks) and most notorious of the indigenous land snails of St Helena. It could have been one of the smaller species Banks saw, however, and Benson (1851) thought it could have been his own *Helix remota* [? = *Oxychilus alliarius* (Miller)]. Unfortunately Banks gave no fuller information. *C. nonpareil* has frequently been referred to as 'the great extinct Land Snail of St Helena' and there is no reliable record of its ever having been seen alive. From the well-preserved appearance of some of those in collections today, however, it could have been living in 1771; during an expedition to the island, Mr A. Loveridge found a worn specimen at 900 feet on the lower slopes of Bencoolen on 26 November 1964 (T. Pain *in litt.*, 4 July 1968).

Dispersal of the collected Material

Many of the officers and seamen who sailed with Cook returned with collections of shells and other 'curiosities'. But few of them intended to keep such things; they wanted to sell them. Because such material was almost unknown in Europe, dealers were willing to pay well for it; they knew they would make a handsome profit when they hawked it in turn to wealthy collectors. George Humphrey (1745–1830), London's principal dealer in natural objects, was there to greet the men of the 'Resolution' in 1775; he paid nearly £150 for specimens on that occasion (Dance, 1966: 100). He was there again in 1780; so was Thomas Martyn (*fl.* 1760–1816), soon to be famous for his iconography of shells, *The Universal Conchologist*, who emptied his purse with a prodigality that must have amazed Humphrey and others present. For rather more than two thirds of the shells brought back in the 'Resolution' and 'Discovery' Martyn, on his own admission, paid four hundred guineas! Humphrey laid out a mere twenty pounds, and the only other dealer to buy shells spent a hundred (DANCE, 1966: 100). DANIEL BOULTER (1740–1802), a dealer in natural and artificial objects and who opened the 'Museum Boulterianum' in Great Yarmouth, 'spent a day on Cook's ship [which one?] and purchased many articles' (SOUTHWELL, 1908: 116). His *Museum Boulterianum* lists many South Sea shells and most of them were for sale (BOULTER, 1793).

Not all the shells were acquired by dealers. The majority of those gathered on the first voyage were retained by their owners. That BANKS and SOLANDER had large shell collections of South Sea material is evident from the correspondence of JOHAN ALSTRÖMER (1742–86) of Alingsås, Sweden, who visited England 1777–78 and was befriended by them in London. ALSTRÖMER was anxious to acquire natural objects and ethnographical material to enrich the family museum, and he was able to realize this ambition fully. Writing home on 2 June 1778 he said: 'he [BANKS] has . . . promised Duplicates of all His collections of Herbs, Shells and Insects and that for ever . . . from Solander I have received a promise of all South Sea shells, which nearly all are new' (RYDÉN, 1963: 29). On 10 July he wrote: 'Tomorrow we shall go through, or split, Solander's South Sea shells and then Hr. Banks's, so that I hope to grow rich on it' (RYDÉN, 1963: 50–51). Finally, on 24 July, he wrote: 'Today I have been occupied with going through Hr. Banks's shells, which were in several packing chests, and which have not previously been opened since his return from the South Seas, for He still has not his Cabinet of Shells in order. He opened them solely for me, to give me Duplicates of them, and packed them down again in the chests' (RYDÉN, 1963: 51).

The ultimate fate of BANKS's shells is not clear. The so-called BANKS collection, now in the British Museum (Natural History), has been studied by WILKINS (1955); but this would be only a small portion of what was evidently a large collection.* It is important to note BANKS's obvious reluctance to part with his shells. Perhaps the Duchess of PORTLAND (1714–85) and ALSTRÖMER were the only recipients of his duplicates during the years when South Sea shells were difficult to obtain. SOLANDER seems to have been just as parsimonious. PARKINSON, who died before the completion of the first voyage, had gathered many shells and these were acquired, ultimately, by a prominent Quaker, JOHN FOTHERGILL (1712–80); they may now be in the Hunterian Museum at Glasgow

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* The shells studied by WILKINS may not have belonged to BANKS anyway. The paper lining the specimen boxes bears the same *Pro-Patria* watermark that can be seen on many of SOLANDER's manuscript sheets; and most, if not all, of the accompanying labels are written by SOLANDER. According to WILKINS the shells must have come to the British Museum in 1863 when the Linnean Society handed over a number of its collections. But the Linnean Society also held SOLANDER's shells at one time (LEACH, 1852: 254) and it is just as reasonable to suppose that they were presented to the British Museum instead of or in addition to BANKS's. Their original ownership is unimportant, however, as they certainly belonged to BANKS or SOLANDER: many of them were undoubtedly collected during the first voyage, and a few during the second (WILKINS, 1955: 113).

University.* Marmaduke Tunstall (1743–90), English ornithologist and collector, acquired a small series of specimens 'brought from the South Seas, New Zealand & other places visited by the ship *Endeavour*'; he sent 200 of them to Linnaeus in 1772—probably the only voyage shells the great man ever saw (Dance, 1967: 3).

After the second voyage was over, some of the participants offered shells and other objects to Banks. A gunner's mate on the 'Resolution', John Marra (1746–76), wrote, some time in 1775: 'Having met with extraordinary good success to the S'd [Southward] and elsewhere, from many strange Isles I have procured your Honour a few curiosities as good as could be expected from a person of my capacity, together with a small assortment of shells, such as was esteem'd by pretended Judges of Shells. We have many experimental men in our ship that pretend to know' (Smith, 1911: 45). Presumably the Forsters were included among the 'experimental men'. J. R. Forster himself also tried to sell shells to Banks but without success (Dawson, 1958: 339). Even Cook had some to dispose of. Writing to Banks on 21 August 1775 Solander said: 'Captain Cook has sent all his curiosities to my apartment at the [British] Museum. All the shells are to go to Lord Bristol [Augustus John Hervey (1724–79)]' (Smith, 1911: 45).

As noted above most of the shells found during the third voyage were bought by dealers. 'All the rest of the shells', said Martyn in 1780, 'are positively in the cabinets of Mr Banks, Dr Fordyce† & two other Gentlemen' (Dance, 1966: 100). This is not strictly true, however, as at least one man, an officer of the 'Discovery', had retained some, and these were sold by auction in 1781. The title-page of the sale catalogue particularly mentions 'some Hammer Oysters, and other curious Shells' (Anon., 1781); and shells comprised 46 of the 248 lots. Some of the shell lots are accompanied by locality information, and these, together with prices given for some, are listed below.

Lot 33	Two hammer oysters [*Malleus* sp.], from Pulo Condore [i.e. Kondor Island]	
Lot 98	A small trumpet, a muricated Trochus, N.Z. [i.e. New Zealand] and 2 Surinam toads	[2s 6d]
Lot 104	A large spider [*Lambis* sp.], from N.A. [i.e. New Amsterdam = Tongatabu, Friendly Islands]	]2s]
Lot 113	Two fine iris ear shells [*Haliotis* (*Paua*) *iris* Gmelin], N.Z...	[6s]
Lot 117	A fine bear's-paw shell [*Hippopus hippopus* (L.)], from ditto [i.e. Friendly Islands]	[3s 6d]

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* They were acquired only after much tedious wrangling. Stanfield Parkinson fell out with Banks over the disposal of his brother's effects and Fothergill bought the shells in an attempt to reconcile the two men (Wilkins, 1955: 75).

† Dr George Fordyce (1736–1802), prominent physician in Aberdeen and later in London. His shell collection was well known for its rarities.

Lot 118	A fine devil's-claw shell [*Lambis* sp.] from ditto	[2s 6d]
Lot 128	A large purpura-shell, from N. Amsterdam	
Lot 150	Six fine leopard cowries [? *Cypraea tigris* L.], Otaheite [i.e. Tahiti]	
Lot 172	Two fine spider shells [*Lambis* sp.], N.A.	[2s]
Lot 222	Two fine pink mouth poached egg cowries [*Ovula costellata* (Lamarck)], from N.A. where they are worn as ornaments	

Soon the shells gathered by Cook's men were to be found in cabinets throughout Europe, and the value of a collection was now judged largely on the quantity and quality of the South Sea specimens included in it. British cabinets were well stocked and for the first time began to outshine those on the continent. Apart from Banks, Solander and Fothergill there were three persons whose cabinets were greatly augmented by South Sea material: Henry Seymer (1745–1800), the Duchess of Portland and Sir Ashton Lever (1729–88). Seymer acquired his specimens from dealers, but the Portland and Lever collections, though enriched by shells bought from dealers or acquired at auctions, benefited from gifts of shells from leading participants in the voyages. The Portland collection was especially rich in voyage shells as can be seen from the *Portland Catalogue*, published shortly after their owner died (Lightfoot, 1786); and the *Catalogue of the Leverian Museum*, published long after Lever's death (Donovan, 1806), shows that he also had been well endowed in this respect. The following entries are typical of the many contained in the *Portland Catalogue*.

Lot 1603	*Venus erosa, S.* [*Batissa triquetra* Deshayes] *a large and singular freshwater Bivalve, from* New South Wales, extremely rare .... [Fordyce, £2 8s]..
Lot 3832	A very large and fine specimen of the white variety of Ostrea Malleus L. [*Malleus albus* Lamarck] brought by *Capt. Cooke* from the *Coral Reef* off *Endeavour River* on the Coast of New Holland —very rare .... [Cash, £4 4s]
Lot 3992	A neat small specimen of Trochus Solaris, *L.* var. Imperialis, or the Imperial Sun [*Astraea heliotropium* (Martyn)], from *Cloudy Bay, New Zealand—extremely scarce* .... [Dillon, £4 6s]

Many shells were bought at the Portland sale by Dillon, an agent working for Charles Alexandre, Duke of Calonne (1734–1802), and in the *Museum Calonnianum* (a 'specification' of his collection and not a true sale catalogue) many of them are listed once more (Humphrey, 1797). As late as 1825 some of them crop up again in the *Tankerville Catalogue* (Sowerby, 1825). Typical of the entries in the *Catalogue of the Leverian Museum* are the following.

Lot 2588 The clouded Persian crown melon (*Voluta amphora* Soland) [*Melo amphora* (Lightfoot)] of great magnitude, *being twelve inches and a half* in length, brought from the *northern part of N.S. Wales, by Captain Cook*

Lot 1881 A large and fine purple-ringed trochus [*Calliostoma annulatum* (Lightfoot)], Nootka Sound; very rare ...... [Sivers, 17s]..

Lot 87 (*Last day but two of sale, p. 4*) A most beautiful variety of the painted nerita [*Nerita polita* L.], having three rich pink bands on a dark clouded ground, taken from an ornament worn by a native of one of the Sandwich Islands ([i.e. Hawaii]—very rare.. [Tankerville, £9]

Lever's most valuable shell, an unusual variety of *Astraea heliotropium* (Martyn), is discussed by Wilkins (1954) and Dance (1966: 110; 1969: 49–50).

There are several other catalogues advertising sales of shells by auction which contain references to shells gathered during the voyages. Of these the most useful are the ones advertising sales of the following collections: Humphrey (1779), Boulter (1793), Calonne (Anon., 1801), William Bullock (1812), Mrs Angus (Dubois, 1821). From these and other contemporary sources it is evident that dealers were the principal disseminators of voyage shells; and one or two of them are known to have promised money to Cook's men to induce them to collect material (some of the participants in the third voyage were given money by Martyn before they took to sea). Whatever the scientific value of the shells brought back by Cook's men, the overriding incentive to collect them was the prospect of making money: 'as mankind will ever be stimulated to exertion by the hopes of gain, sailors, and persons wholly unacquainted with conchology, have thought it worth their while to bring home what they could, as an object of traffick' (Wood, 1815: xxxii-xxxiii). We should be grateful to those involved in this kind of 'traffick'; at least they ensured that the South Sea shells were distributed and thus brought to the attention of competent conchologists; would that this could be said of Banks, Solander and the other 'experimental men' who sailed with Cook.

Contemporary Literature

The catalogues mentioned above, though useful in several ways, were incidental products of activities intended to promote sales, not science; the *Portland Catalogue* is the only one of them which has any standing in scientific literature now (the *Tankerville Catalogue* should not be bracketed with them as it is primarily a scientific publication conceived in a quite different scientific atmosphere), and this only because its compiler utilized a currently-acceptable zoological nomenclature [the valid zoological names in it are discussed by Rehder, 1967]. Fortunately, some of the few contemporary publications which can be called scientific, at least in intent, are well illustrated, and from these we can obtain much useful information on what was collected and where.

Nothing appeared in print until 1778—seven years after the completion of the first voyage—when FRIEDRICH AUGUST ZORN VON PLOBSHEIM (1711–89), Curator of natural history of the Literary and Philosophical Society of Danzig, published an illustrated paper on shells of the 'South Land' (ZORN, 1778). The shells, all purchased from HUMPHREY, had been brought back in the 'Resolution' in 1775. ZORN, like so many of his generation, cared little about conforming to Linnaean nomenclature and he published the names on HUMPHREY's labels without qualification: 'The lesser Cart-rut; from New Zealand', 'The little Poison; from New Zealand', 'The black flutted Catsmouth, with its operculum; from New Holland', 'The dark coloured, smooth mottled and beaded Necklace-Perriwinkle; from the Island Amsterdam in the South-Seas'. His illustrations include the earliest-known representations of New Zealand shells. The first *book* to provide information on South Sea shells was the third edition of D'ARGENVILLE's *La Conchyliologie* (FAVANNE & FAVANNE, 1780). This contains numerous references to shells from Tahiti and New Zealand, and several Pacific species are there illustrated for the first time.* In 1782 LORENZ SPENGLER (1720–1807) of Copenhagen described and illustrated, in *Der Naturforscher*, some other shells originating with HUMPHREY (SPENGLER, 1782); his illustrations depict shells of *Struthiolaria papulosa* (Martyn) and *Pelicaria vermis* (Martyn), both characteristic New Zealand species. In the same year and in the same publication JOHANN HERMANN of Strasburg described the bivalved species now known as *Modiolarca impacta* (Hermann) (HERMANN, 1782); a long discussion on this species —the first of the voyage novelties to be validly named and described—is given by WILKINS (1955: 97–98). In 1783 JOHANN HIERONYMUS CHEMNITZ (1730–1800) published an extensive article on South Sea shells, again in *Der Naturforscher*, in which he listed and described numerous species and repeated the vernacular names written on their accompanying labels (CHEMNITZ, 1783); and the article opens with a criticism of COOK's naturalists for having done nothing to publicize their conchological discoveries. In 1781, however, CHEMNITZ had published the fifth volume of his continuation of the *Neues systematisches Conchylien-Cabinet* in which he discussed and illustrated many South Sea shells (MARTINI & CHEMNITZ, 1769–95); and it was from this famous work that many collectors gained their knowledge of the shells brought back by COOK's men.

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* In the library of the British Museum (Natural History) are three volumes of original coloured drawings of shells and other invertebrates by JACQUES GUILLAUME DE FAVANNE (n.d.). Among the shells illustrated are several which must have been gathered during the voyages, and some of these are labelled (usually incorrectly) 'Bottanibaye' [= Botany Bay]. Some well-known New Zealand species are represented, including *Cookia sulcata* (Gmelin) and *Astraea heliotropium* (Martyn). The drawings are undated but probably date from the early 1780's; nearly all are signed 'Guil. Jac. Defavanne Pinx'.

About 1780 Martyn began work on *The Universal Conchologist*, justly celebrated for its lovely paintings of shells and justly rejected as a source of validly proposed scientific names (MARTYN, 1784–87).* The story behind the production of this collection of coloured plates is fascinating but is peripheral to the present subject; the details are given by DALL (1905; 1907), DANCE (1966: 101–103) and LYLE (1969).† Although this is the most useful of the contemporary works it must be pointed out that its author did not distinguish between the shells collected by COOK's men and those collected by the men who sailed with BYRON and WALLIS, his British predecessors in the Pacific.

Later literature adds little that is not derived from these works. But one book published in the nineteenth century deserves to be mentioned: *The Naturalist's Repository* by EDWARD DONOVAN, the cataloguer of the LEVER collection (DONOVAN, 1822–34). This contains anecdotes of several shells gathered during the voyages which DONOVAN illustrated from LEVER's collection. Before the fifth and final volume of Donovan's book had appeared, however, collectors had lost interest in the spoils of voyages which had taken place over 50 years earlier. They were now boggling over the incomparably greater riches brought back to England from Polynesia and South America by the redoubtable HUGH CUMING.

MOLLUSCS COLLECTED DURING COOK'S VOYAGES

The only previous attempts to list all the molluscan species collected during the voyages is that of MARTENS (1872). Based entirely on contemporary literature it is now so out of date nomenclaturally as to be largely unintelligible. Nineteen years later he published a supplementary list which added a handful of species based on nineteenth-century literature (MARTENS, 1891). IREDALE (1956) gives a list of species from New South Wales which is too brief to be useful. In this new list the number of species is much greater than that given by MARTENS largely because it incorporates those in the so-called BANKS collection.

A geographical arrangement is preferred to a single systematic list; consequently some species are listed more than once. Unfortunately it is often impossible to ascertain the provenance of species collected in the island groups of the central Pacific, although MARTENS gave lists from each group. Undoubtedly he obtained many of his records from *The Universal Conchologist*; and for many of them, e.g. species recorded from Alaska and New Zealand, Martyn's book is a reliable source. As has been mentioned above (p. 372), however, Martyn also dealt with shells collected during the voyages of some of Cook's predecessors in the Pacific; some of the central Pacific species illustrated by him, therefore, may not have originated from places visited by Cook. The names printed in ***bold italic*** are of species which it is believed were unknown in Europe prior to the voyages.

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* See ICZN Opinion 456. MARTYN's specific names for nine species of Gastropoda occurring in the New Zealand area were subsequently validated under the plenary powers of the ICZN (Opinion 479).

† Complete copies of the book should comprise 160 plates (exclusive of the frontispiece) and are usually bound in four volumes, royal quarto. As such copies are extremely scarce and are seldom offered for sale it may be useful to record the locations of some of them: British Museum (Natural History); British Museum (Antiquities); Cambridge University; Teyler Museum, Haarlem, Holland; Australian Museum, Sydney; Academy of Natural Sciences, Philadelphia; New York Public Library [this copy was formerly owned by P. DAUTZENBERG who reproduced a letter of MARTYN's which is inserted in it (DAUTZENBERG, 1917)].

Madeira

Leptaxis undata (Lowe)

Brazil

Cerithium atratum (Born)
Cyphoma gibbosa (L.)
Cypraea cinerea Gmelin
Cymatium (*Monoplex*) *parthenopeum* (Salis)
Leucozonia brasiliana (d'Orbigny)
Oliva brasiliana Lamarck
Aulacomya ater ater (Molina)
Aulacomya ovalis (Lamarck)
Pinctada vulgaris (Schumacher)
Pteria argentea (Reeve)
Macrocallista maculata (L.)
Tivela mactroides (Born)
Tivela trigonella (Lamarck)
Dosinia concentrica (Born)
Ventricola rigida (Dillwyn)

Tierra del Fuego

Patinigera magellanica (Gmelin)
Fissurella picta Lamarck
Acanthina monodon (Pallas)
Trophon geversianus (Pallas)
Trophon philippianus Dunker
Trophon (*Stramonitrophon*) *laciniatus* (Hupé)
Adelomelon ancilla (Lightfoot)
Aulacomya ater ater (Molina)
Choromytilus chorus (Molina)
Mytilus edulis L.
Gaimardia trapezina (Lamarck)
Eurhomalea exalbida (Dillwyn)

North West Coast of America

Calliostoma annulatum (Lightfoot)
Calliostoma doliarium (Holten)
Calliostoma ligatum (Gould)
Fusitriton oregonense (Redfield)
Nucella lamellosa cymica (Dall)
Pterorytis foliata (Gmelin)
Thais lima (Gmelin)
Euthria dira (Reeve)

Central Pacific: Tuamotu, Society, Tonga (Friendly), Cook and Fiji Groups

Turbo argyrostomus L.
Turbo chrysostomus L.
Tectarius grandinatus (Gmelin)
Cerithium serratum Bruguière
Ovula costellata Lamarck
Cypraea reticulata Gmelin
Cypraea ventriculus Lamarck
Cypraea caputserpentis L.
Cypraea tigris L.
Cypraea annulus L.

Cypraea aurantium Gmelin[*]
Charonia tritonis (L.)
Leucozonia amplustre (Dillwyn)
Peristernia columbarium (Gmelin)
Latirus iris (Lightfoot)
Oliva spp.
Mitra terebralis Lamarck
Swainsonia casta (Gmelin)
Imbricaria punctata (Swainson)
Conus textile L.
Conus striatus L.
Conus litteratus L.
Conus sponsalis Hwass
Conus tessulatus Born
Conus arenatus Hwass
Conus eburneus Hwass
Conus pulicarius Hwass
Conus ebraeus L.
Conus vermiculatus Lamarck
Conus quercinus Lightfoot
Bulla ampulla L.
Cassidula nucleus (Gmelin)
Physa sp.
Partula faba (Gmelin)
Partula otaheitana (Bruguière)
Modiolus auriculatus Krauss
Modiolus metcalfei Hanley
Gloripallium pallium (L.)
Hippopus hippopus (L.)
Tridacna sp.
Pycnodonte hyotis (L.)
Malleus malleus (L.)

New Caledonia

Turbo porphyrites Gmelin
Astraea (*Cyclocantha*) *stellare* (Gmelin)
Nerita undata L.
Terebralia palustris (L.)
Cypraea moneta L.
Bursa bufonia (Gmelin)
Conus caledonicus Hwass[†]
Placostylus elongatus (Lightfoot)

New Guinea

Nautilus scrobiculatus Lightfoot

Java

Cypraea tigris L.
Conus imperialis L.

Australia

Haliotis (Notohaliotis) ruber (Leach)
Cellana tramoserica (Holten)
Austrocochlea obtusa (Dillwyn)
Ninella torquata (Gmelin)
Subninella undulata (Lightfoot)
Phasianella australis (Gmelin)
Nerita punctata Quoy & Gaimard
Nodilittorina pyramidalis (Quoy & Gaimard)
Bembicium melanostoma (Gmelin)
Cerithideopsilla fluviatilis (Potiez & Michaud)
Pyrazus ebeninus (Bruguière)
Contumax nodulosum (Bruguière)
Ovula ovum (L.)
Calpurnus verrucosus (L.)
Cypraea cicercula L.
Cypraea globulus L.
Cypraea childreni Gray
Cypraea staphylaea L.
Cypraea limacina Lamarck

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[*] Evidence suggesting that this species was unknown in England before 1775 is given by Dance (1966: 108). A colourful account, suggesting an earlier importation, is given by Donovan (1822–34 I); the substance of this is quoted verbatim by Dance (1969: 60–61).

[†] The holotype of this species, now in the Muséum d'Histoire Naturelle, Geneva, was obtained on one of the Cook voyages and passed into the hands of the Duchess of Portland; she sold it to C. H. Hwass (fide Mermod, 1947).

Cypraea nucleus L.
Cypraea helvola L.
Cypraea poraria L.
Cypraea erosa L.
Cypraea annulus L.
Cypraea moneta L.
Cypraea obvellata Lamarck
Cypraea onyx L.
Cypraea errones L.
Cypraea caurica L.
Cypraea punctata L.
Cypraea asellus L.
Cypraea clandestina L.
Cypraea humphreysii Gray
Cypraea ziczac L.
Cypraea hirundo L.
Cypraea ursellus Gmelin
Cypraea chinensis Gmelin
Cypraea teres Gmelin
Cypraea cribraria L.
Cypraea isabella L.
Cypraea testudinaria L.
Cypraea argus L.
Cypraea arabica L.
Cypraea reticulata Gmelin
Cypraea histrio Gmelin
Cypraea mauritiana L.
Cypraea tigris L.
Cypraea lynx L.
Cypraea vitellus L.
Cypraea carneola L.
Cymatium rubeculum (L.)
Cymatium pyrum (L.)
Cymatium tripus (Lamarck)
Cymatium nicobaricum (Röding)
Cymatium (*Monoplex*) *parthenopeum* (Salis)
Cymatilesta spengleri (Perry)
Distorsio anus (L.)
Bursa albovaricosa (Reeve)
Bursa granularis (Röding)
Ficus ficus (L.)
Murex ternispina Lamarck
Murex (*Haustellum*) *haustellum* L.
Chicoreus torrefactus (Sowerby)
Chicoreus brunneus (Link)
Chicoreus cornucervi (Röding)
Dicathais orbita (Gmelin)
Nucella amygdala (Kiener)
Phos senticosus (L.)
Engina alveolata (Kiener)
Galeodes pugilina (L.)
Syrinx aruana (L.)
Latirus polygonus (L.)
Latirus nodatus (Quoy & Gaimard)
Latirus gibbulus (Gmelin)
Peristernia nassatula (Lamarck)
Peristernia ustulata (Lamarck)
Fasciolaria filamentosa (Röding)
Fusinus colus (L.)
Fusinus tuberculatus (Lamarck)
Melo amphora (Lightfoot)
Conus anemone Lamarck
Conus catus Hwass
Conus coronatus Gmelin
Conus distans Hwass
Conus eburneus Hwass
Conus ebraeus L.
Conus figulinus L.
Conus flavidus Lamarck
Conus generalis L.
Conus lividus Hwass
Conus quercinus Lightfoot
Conus nussatella L.
Conus litteratus L.
Conus magus L.
Conus marmoreus L.
Conus pulicarius Hwass
Conus textile L.
Conus virgo L.
Conus vermicularis Lamarck
Hydatina physis (L.)
Bulla botanica Hedley
Anadara trapezia (Deshayes)
Modiolus auriculatus Krauss
Amygdalum arborescens (Dillwyn)
Trichomya hirsuta (Lamarck)
Septifer bilocularis (L.)
Lithophaga teres Philippi
Mytilus planulatus Lamarck
Aulacomya maoriana Iredale
Malleus albus Lamarck
Electroma georgiana (Quoy & Gaimard)
Electroma punctulata (Reeve)
Austropteria lata (Gray)
Pinctada albina (Lamarck)
Pinctada radiata (Leach)
Pinna muricata L.
Mimachlamys asperrima (Lamarck)
Lima (Stabilima) tadena Iredale
Lima (Austrolima) nimbifer Iredale
Ostrea angasi Sowerby
Crassostrea commercialis Iredale & Roughley
Batissa triquetra Deshayes
Pexacodakia rugifera (Reeve)
Lentillaria tigerina (L.)
Codakia fimbriata (L.)
Lioconcha castrensis (L.)

Lioconcha varians (Hanley)
Circe scripta (L.)
Gafrarium pectinatum (L.)
Gafrarium tumidum Röding
Pitar pellucida (Lamarck)
Macrocallista maculata (L.)
Dosinia anus (Philippi)
Periglypta puerpera (L.)
Antigone reticulata (L.)
Glycydonta marica (L.)
Placamen foliacea (Philippi)
Paphia philippinarum (Reeve)
Asaphis deflorata (L.)
Corbula tunicata Hinds
Nautilus pompilius L.

New Zealand

Haliotis (Sulculus) virginea Gmelin
Haliotis (Paua) iris Gmelin
Cellana radians (Gmelin)
Cellana denticulata (Martyn)
Cellana stellifera (Gmelin)
Maurea pellucida (Valenciennes)
Maurea punctulata (Martyn)
Maurea cunninghami (Griffith & Pidgeon)
Trochus (Thorista) viridis Gmelin
Melagraphia aethiops (Gmelin)
Cantharidus opalus opalus (Martyn)
Cantharidus purpurea (Gmelin)
Lunella smaragda (Gmelin)
Modelia granosa (Martyn)
Cookia sulcata (Gmelin)
Astraea heliotropium (Martyn)
Nerita (Melanerita) melanotragus Smith
Struthiolaria papulosa (Martyn)
Pelicaria vermis (Martyn)
Cymatium (*Monoplex*) *parthenopeum* (Salis)
Haustrum haustorium (Gmelin)
Dicathais scalaris (Menke)
Lepsithais lacunosus (Bruguière)
Austrofusus glans (Röding)
Cominella maculosa (Martyn)
Cominella (Acominia) adspersa (Bruguière)
Buccinulum lineum (Martyn)
Alcithoe arabica (Gmelin)
Amphibola crenata (Gmelin)
Modiolarca impacta (Hermann)
Perna canaliculus (Gmelin)
Aulacomya maoriana Iredale
Chione stutchburii (Wood)
Notirus reflexus (Gray)
Amphidesma (Paphies) australe (Gmelin)

Hawaiian Islands

Nerita polita L.
Hydatina physis (L.)

China

Perna viridis L.

Pulo Condore (Kondor Island)

Cerithium clava (Gmelin)
Cerithium asperum (L.)
Distorsio anus (L.)
Fusinus tuberculatus (Lamarck)
Conus ammiralis L.
Cyclophorus involvulus (Müller)
Malleus malleus (L.)
Libitina oblonga (Reeve)
Fulvia australis (Sowerby)

Ascension Island

Nerita ascensionis Gmelin
Ostrea cucullata Born

Pelagic and Planktonic Species

Janthina globosa (Swainson)
Janthina janthina (L.)
Glaucus atlanticus Forster
Clio spp.
Cucioteuthis molinae (d'Orbigny)

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J. Conch. **26**: 380–385. (1971)

THE EXTRAPALLIAL CAVITY IN *ANODONTA CYGNEA* (L.) INHABITED BY AN INSECT LARVA

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(*Read before the Society*, 18 *March* 1967)

Two examples are recorded of the extrapallial cavity of the mantle in specimens of *Anodonta cygnea* (L.) undergoing shell repair being inhabited by a chironomid larva of the genus *Glyptotendipes*, possibly *G. paripes* Edwards (1929). The mantle reacts with the aggregation of large numbers of amoebocytes at the sites of infection accompanied by breakdown of the outer mantle epithelium. There is some evidence that the larvae may make use of the amoebocytes and other mantle cells as food material and that the association is therefore parasitic in nature.

INTRODUCTION

Since DE WAELE (1930) drew attention to the extrapallial cavity of the mantle in *Anodonta cygnea*, i.e. the space lying between the outer mantle surface and the inner side of the shell, as the site of a fluid with a potentially important role in shell secretion, much work has been directed towards elaborating its properties (for recent summary see WILBUR, 1964). In the course of investigations into the process of shell repair in species of *Anodonta*, the results of which are reported fully elsewhere (BEEDHAM, 1965), this cavity was unexpectedly found to contain in two instances specimens of a chironomid larva. The record of this association is of interest not only to the entomologist (BEEDHAM, 1966), in view of the apparent rarity with which insect larvae invade the bivalve molluscs, but to the malacologist, on account of their unusual location within the host.

THE ASSOCIATION

The specimens of *A. cygnea* in which the larvae were discovered formed part of a series being used to investigate repair of the valves in two different regions, namely, at the margin of the shell, i.e. distal to the attachment of the pallial muscles, and in the mid-region of the valves, i.e. proximal to the pallial line. They were being maintained in one of their natural habitats, Hornsea Mere in East Yorkshire.

One bivalve (specimen A5) had been repairing a marginal hole cut in the right valve, 3 mm deep × 2 mm wide, for a period of almost seven months. This had been effectively covered by the secretion of new shell now firmly attached to the adjoining valve. The second specimen (B19) had accomplished repair of a small hole 1 mm in diameter drilled some nine months previously in the upper part of the left valve. In neither case were the damaged regions, the one cut outside and the other inside the pallial line, artificially protected at the start of the experiment. On being collected, A5 in late October and B19 the following January, the specimens were examined externally to assess the progress of shell repair. There was no indication at this stage that the bivalves had been entered by insect larvae, although in a control specimen collected during the same period as A5 it had been noticed that a similar type of larva was attached to the outer surface of one of the valves.

In both cases the chironomid larvae were discovered on opening the bivalves some time after they had been preserved for further detailed investigation of the regions of mantle and shell concerned with repair. They were found lying between the mantle and shell in the region proximal to the pallial line, i.e. the area designated by DE WAELE (1930) as the upper extrapallial cavity. Both larvae were located beneath the left valves. This in bivalve B19 was the part of the shell experimentally damaged; in specimen A5, however, it was the valve opposite that from which a portion of shell had been removed. The larvae were approximately the same size, some 12 to 14 mm long and 1 mm in diameter, and appear to have been in a normal and healthy state at the time of fixation. They were greenish-brown in colour but may have had a rather different coloration in life. The larvae have been identified as a species of *Glyptotendipes*, possibly *G. paripes* Edwards (1929) which is known to frequent empty mollusc shells, especially those of *Dreissena polymorpha* (Pallas) (WUNDSCH, 1942).

Both specimens appear to have been able to move about freely in the extrapallial cavity of their host, as indicated by the whitish tracks and scars they probably made on the otherwise transparent outer mantle surface (Fig. 1). These marks are due to the aggregation of large flocculent masses of amoebocytes in the sub-epithelial tissues of those regions of the mantle with which the larvae have apparently made physical contact. The massing of amoebocytes in this way is a natural reaction of the mantle in *Anodonta* when it is subjected to unusual conditions, for example exposure to the environment caused by shell damage or friction with various forms of detritus and foreign bodies (BEEDHAM, 1965). The outer mantle epithelium in the affected areas tends to break down and is largely replaced by closely-packed layers of amoebocytes which form a protective barrier between the irritant and the underlying mantle tissues (Plate 16, compare figs. 1, 2 and 3). This is the normal prelude to shell repair when these characteristic reactions of the mantle are stimulated by removal of portions of the valves or ligament (BEEDHAM, 1965).

Although probably capable of locomotion within the necessarily restricted confines of its habitat, the larva in bivalve A5 was, at the time of preservation, firmly fixed in one particular portion of the outer mantle surface. The head of the larva was partly embedded in the mantle tissues and the shape of its body, including the delineation of the segments, clearly imprinted on the outer mantle surface (Fig. 1). The whitish flocculence caused by amoebocytes was particularly marked in and around this area through which the sections illustrated in Plate 16, figures 1 and 2 were taken. Figure 1 also shows the indentation into the outer mantle surface caused by the head region of the larva. It is not possible to estimate how long the larva may have been confined to this one location.

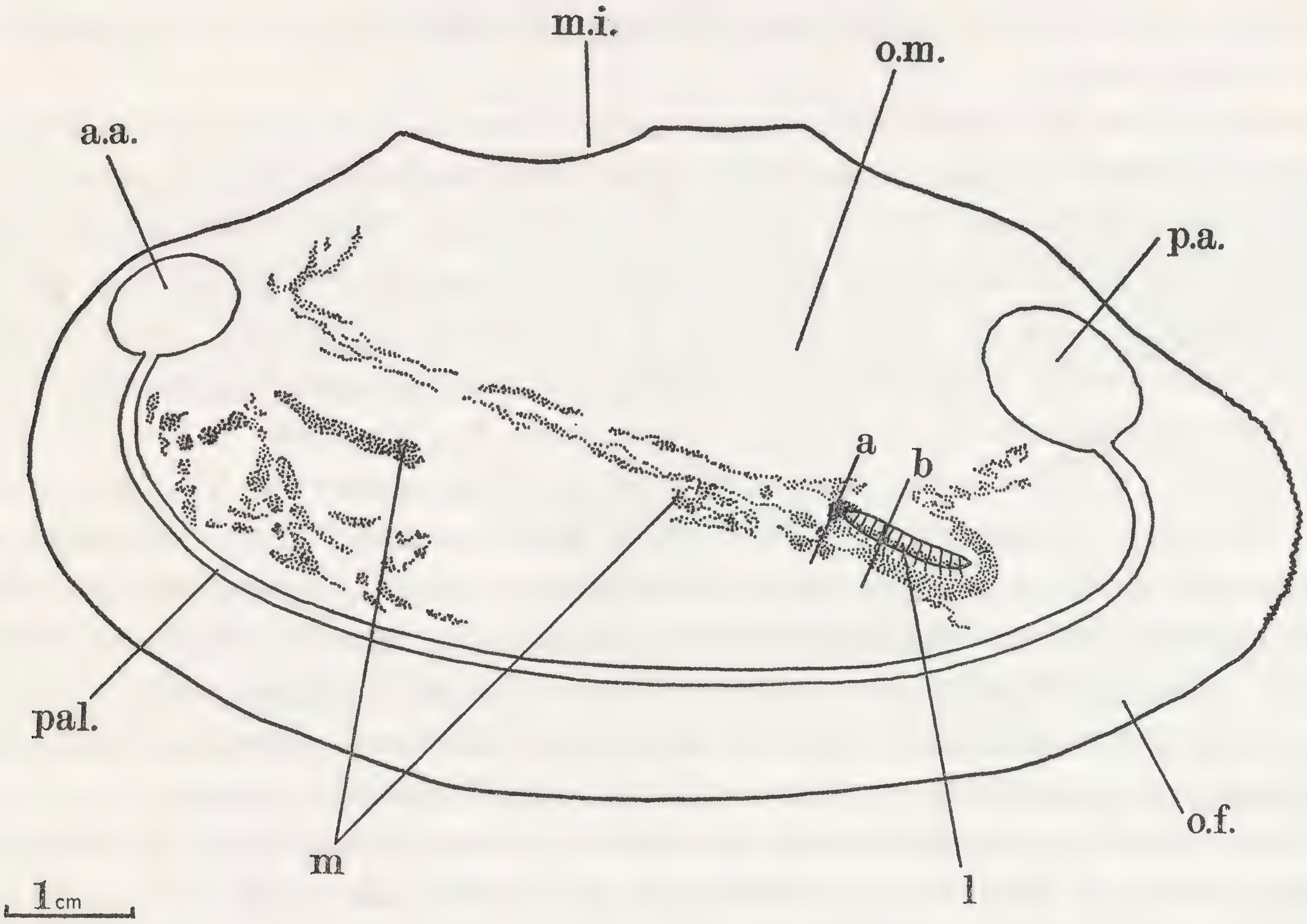

Fig. 1. The outer surface of the mantle of a specimen of *Anodonta cygnea* after removal of the overlying left valve showing the marks (**m**) probably made by a chironomid larva found in the upper extrapallial cavity, i.e. the area bounded by the adductor and pallial muscles. The imprint left by the larva on the mantle surface is shown at point **l** where it was discovered with its head region (pointing towards the anterior adductor muscle) partly embedded in the mantle tissues. For further details see text.

a.a. anterior adductor muscle; **l.** imprint of larva on outer mantle surface; **m.** marks probably caused by larva in the form of flocculent masses of amoebocytes aggregated at the outer mantle surface; **m.i.** mantle isthmus lying beneath ligament; **o.f.** outer surface of outer fold on mantle edge; **o.m.** general outer surface of the mantle; **p.a.** posterior adductor muscle; **pal.** pallial muscles. **a** and **b** represent the planes at which the sections illustrated in Plate 16, figs. 1 and 2 were cut.

Reactions of the mantle of the type described may occur relatively quickly; flocculence of the outer mantle surface can be noticeable after only twenty-four hours. The larva has not, however, been restricted long enough to stimulate shell formation around it, the usual ultimate effect of invasion of the mantle tissues by a foreign body. Despite the changes induced on the outer mantle surface, in neither specimen does the inner surface of the valves appear parti-

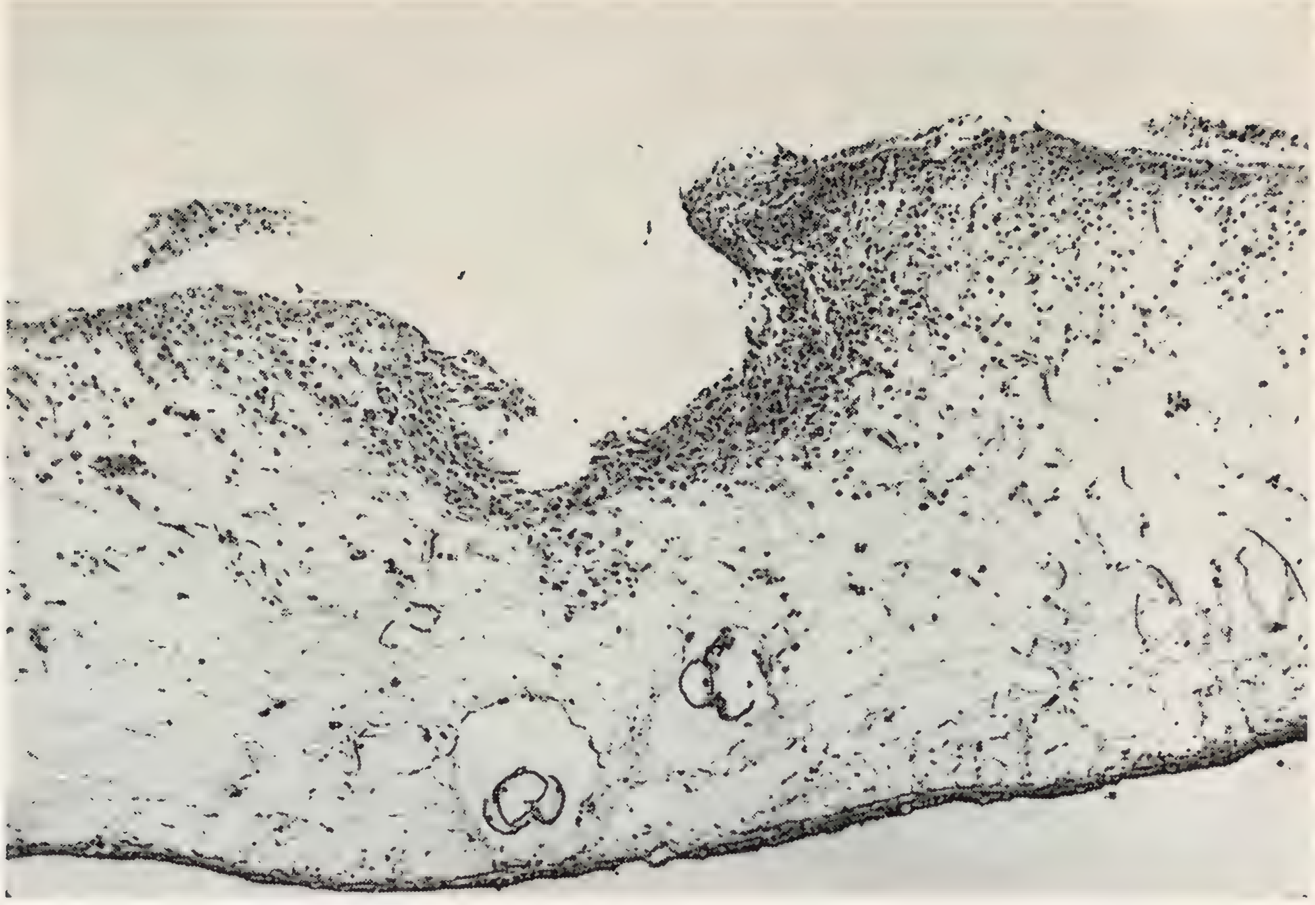

Fig. 1

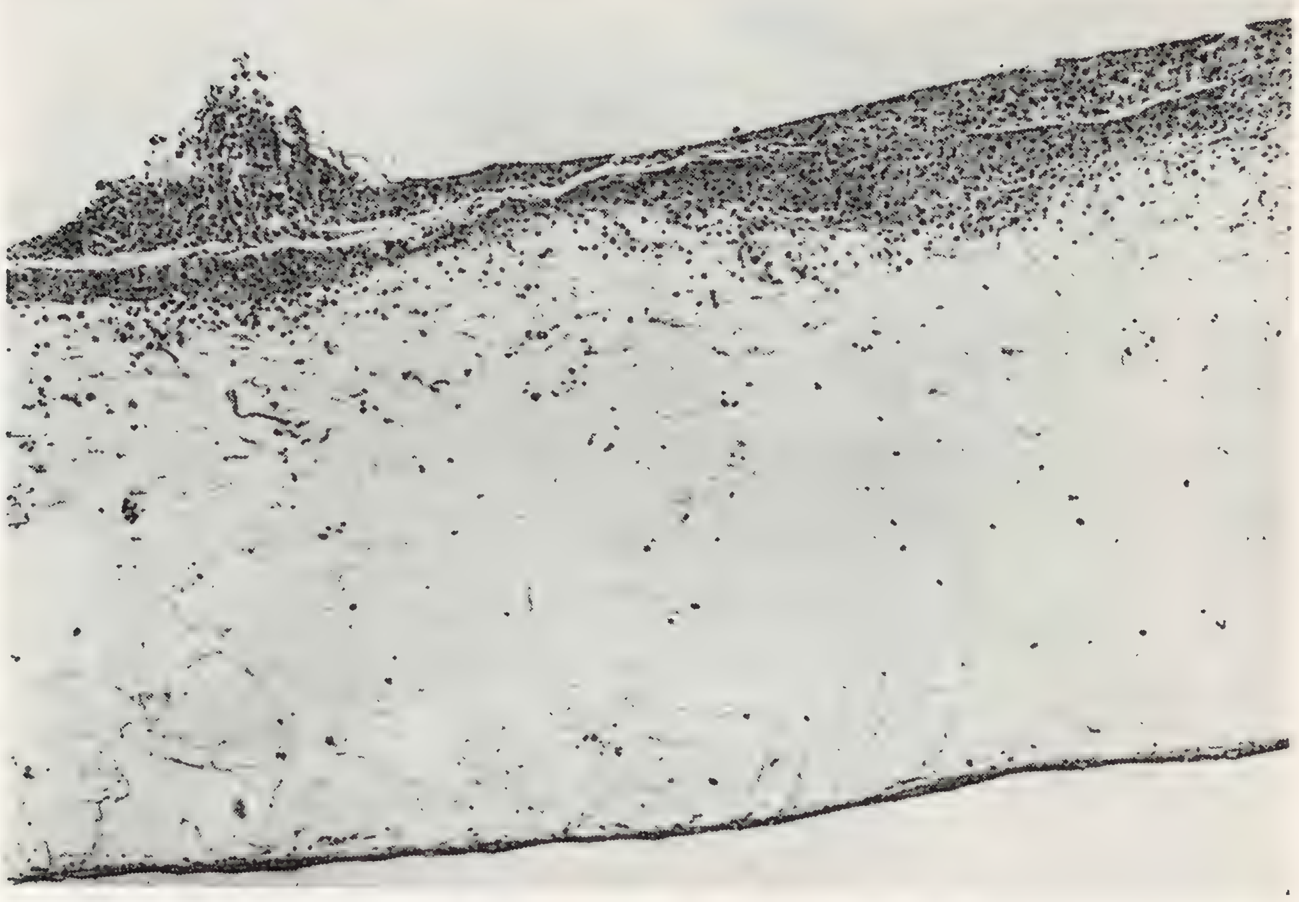

Fig. 2

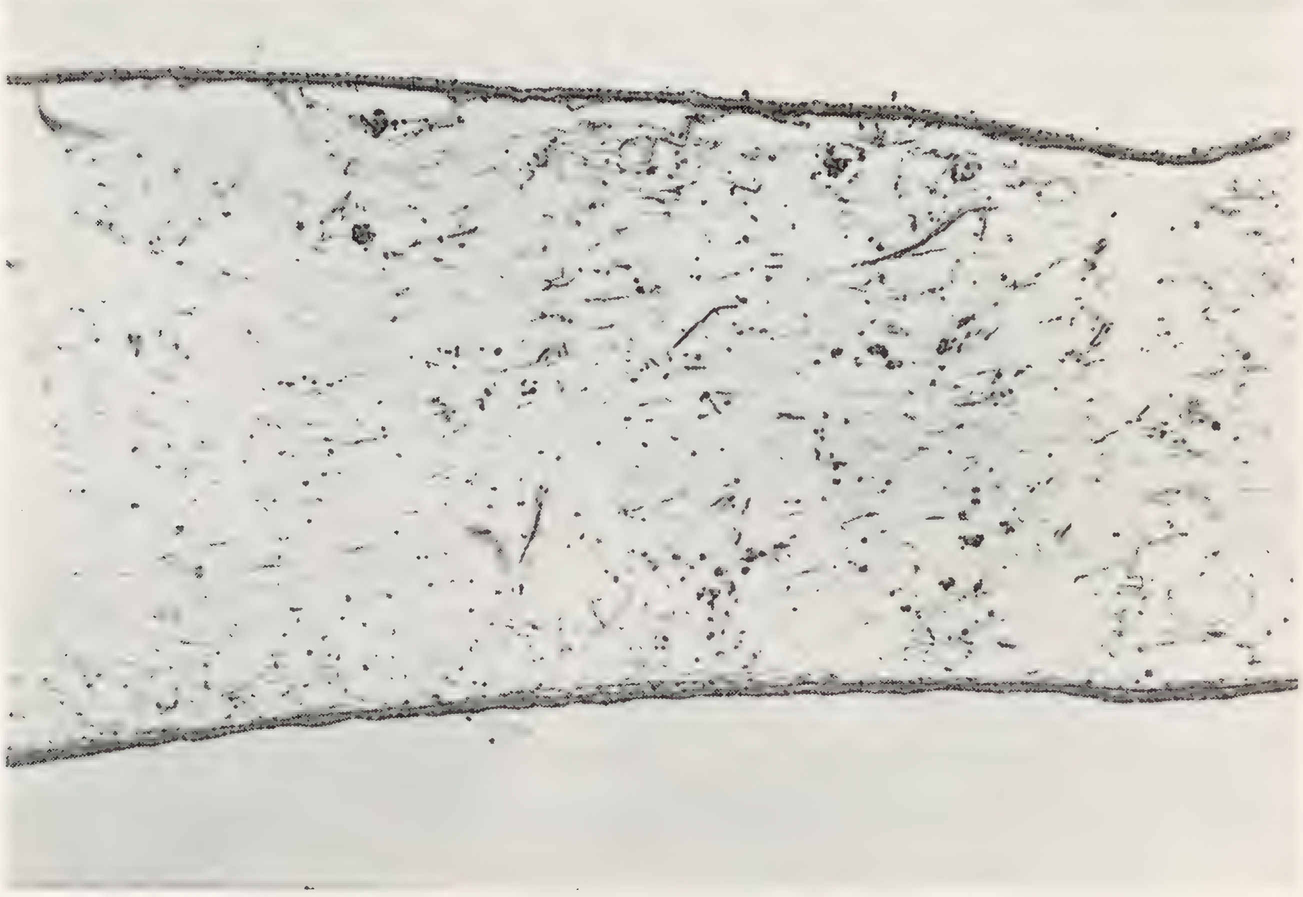

Fig. 3

EXPLANATION OF PLATE 16

Figure 1. Section through the mantle of the specimen of *Anodonta cygnea* illustrated in Text-fig. 1 at point **a** showing the indentation into the outer mantle surface caused by the head region of the chironomid larva accompanied by massing of amoebocytes at the affected region and breakdown of the outer mantle epithelium.

Figure 2. Section through the same at point **b** showing similar effects under the mid-region of the body of the larva.

Figure 3. Section through the normal mantle.
In all sections the outer surface of the mantle is uppermost.

cularly affected by the presence of the larva. Similarly, no modifications could be detected in other parts of the mantle or the rest of the body as a result of the association.

NATURE OF THE RELATIONSHIP

This is believed to be the first recorded instance of a living bivalve being inhabited by an insect larva. *A. cygnea* itself seems to be rarely parasitized by arthropods except for the mites commonly found associated with the gill plates in the mantle cavity (PELSENEER, 1928; MITCHELL & PITCHFORD, 1953). Moreover, apart from its established association with empty shells, there is apparently no previous record of *Glyptotendipes paripes* being found within the tissues of any living mollusc (THIENEMANN, 1954).

There are, on the other hand, several well-authenticated cases of insect larvae associating with gastropods, especially fresh-water pulmonates. Species of *Lymnaea* and/or *Physa* have been reported to act as hosts to various larvae of *Chironomus* and related genera (BARNARD, 1911; EDWARDS, 1929; HOFFMAN, 1931; MATHIAS & BOULE, 1933; JUTTING, 1938; GUIBÉ, 1942) and the occurrence of other dipterous larvae has been recorded in the tissues of *Helicella* (*Heliomanes*) *virgata* (da Costa) (KEILIN, 1919), *Vertigo genesii* Gredler (BHATIA & KEILIN, 1937) and other snails (PELSENEER, 1928). These larvae were found in various localities including the mantle, mantle cavity and digestive gland, and in many cases observers considered them to be parasitic in nature. GUIBÉ (1942) regarded the larval form of *Chironomus varus* Goetghebuer—found endoparasitically in *Lymnaea limosa* (L.)—to be different enough from the type-species (the larva of which is itself an ectoparasite) to constitute a distinct variety, *C. varus limnaei*.

The location of the specimens of *Glyptotendipes* in *A. cygnea* suggests that they also were living effectively at that time as parasites, although the actual association may have been accidental. The larvae were found in a confined space and had no access to the food source in the mantle cavity. Examination of the gut contents of the larva found with its head region partly burrowed in the mantle indicates that it may have used the mantle tissues for food. The gut contained detritus in which could be identified cellular material similar in appearance to the outer epithelial cells of the mantle and to the amoebocytes aggregated at the outer mantle surface. Included also in the detritus, however, are what appear to be the empty valves of several species of diatoms. This type of phytoplankton constitutes the normal diet of the larva of *G. paripes* (WUNDSCH, 1942). BURTT (1940) has shown that probably most *Glyptotendipes* larvae live in tubes in which they spin a silk net for collecting diatoms and other suspended matter in the water for use as food material.

The possible presence of diatom remains in the gut may indicate a fairly recent meal of phytoplankton taken in more natural surroundings although it is not inconceivable that some of this material may have entered through the aperture cut in the shell prior to repair being effected. No such extraneous matter was evident, however, in the vicinity of either larva when the bivalves were opened, nor were the cast skins of any earlier larval stage. It is not possible to determine therefore how long the larvae may have been enclosed within the tissues of their host, although the state of the outer mantle surface suggests that they could have been in the extrapallial cavity for some considerable time.

Similarly, there is no real evidence to indicate the actual point of entry of the chironomids. If the larvae entered the mantle cavity with the inhalent current they would have had to eat their way through the mantle tissues to reach the extrapallial space and yet the inner surface of the mantle showed no signs of damage. It would perhaps seem more reasonable to relate the specialized site of the chironomids to the fact that the shells of the host bivalves had been damaged experimentally. If, however, the larvae had entered directly from the exterior through the apertures cut in the shell they must have done so at a much earlier stage. The areas of shell removal were initially only small and had probably been repaired for some time, whereas the larvae when discovered were fairly large specimens. In addition, the larva which produced the effects illustrated in Fig. 1 would have had to traverse the host from a possible point of entry at the margin of one valve to its ultimate destination beneath the other. There is nothing to show how this could have been accomplished. Even if the larva had remained throughout in the extrapallial cavity, its journey would have involved penetrating or circumventing the line of attachment of the pallial and adductor muscles and passing over the mantle isthmus, a region in which the outer mantle epithelium is known to be closely attached to the inner surface of the ligament (BEEDHAM, 1958).

It will be interesting to discover if the association is ever found in more natural circumstances, or if perhaps it could be induced in bivalves in which the shells are not damaged. Whatever the true character of the relationship, the probability that fairly mature chironomid larvae were able to move about freely within the extrapallial cavity indicates the potential capacity of this space in *Anodonta*, although it could hardly approach DE WAELE's (1930) estimate that the extrapallial fluid constitutes 25% of the total weight of the tissues of the body.

ACKNOWLEDGMENTS

I am grateful for facilties provided at the University of Hull and at the North East London Polytechnic. Dr J. H. MUNDIE, formerly of the Freshwater Biological Association, identified the larva and offered much valuable advice. It is a pleasure to record my thanks again to Prof. E. R. TRUEMAN of the University of Manchester for reading the manuscript and for his help during the initial stages of this work.

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J. Conch. **26**: 386–387 (1971)

NOTE ON A STREPTAXID FROM SEYCHELLES *IMPERTURBATIA LEVIEUXI* (NEVILL & NEVILL)

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(*Read before the Society*, 16 *December* 1967)

Included in a small parcel of land shells sent to me for identification by Mr G Lionnet, Director of Agriculture, Seychelles, was a small streptaxid—taken by the members of an ornithological expedition from Bristol University on Mt Dauban, Silhouette Island, Seychelles—which appears to be a specimen of *Imperturbatia levieuxi* (Nevill & Nevill). It corresponds with the description in all respects except in the dimensions: these are diameter 4·5 mm, height 2·5 mm, in contrast to the 'Alt. 3½, Diam. 2 mm.' given in the original description of *Helix* (*Discus*) *Le Vieuxi*. In all other members of this genus, which is confined to the Seychelles and comprises six species so far described, the diameter is greater than the height. Moreover, a variety *silhouettae* of *levieuxi* is described by Martens (Martens & Wiegmann, 1898: 12), with diameter 7 mm, height 4 mm. This leads me to surmise that an inadvertent transposition of the dimensions of *levieuxi* occurred in the original description. It is noticeable that there is another typographical error in the same paper regarding a different species.

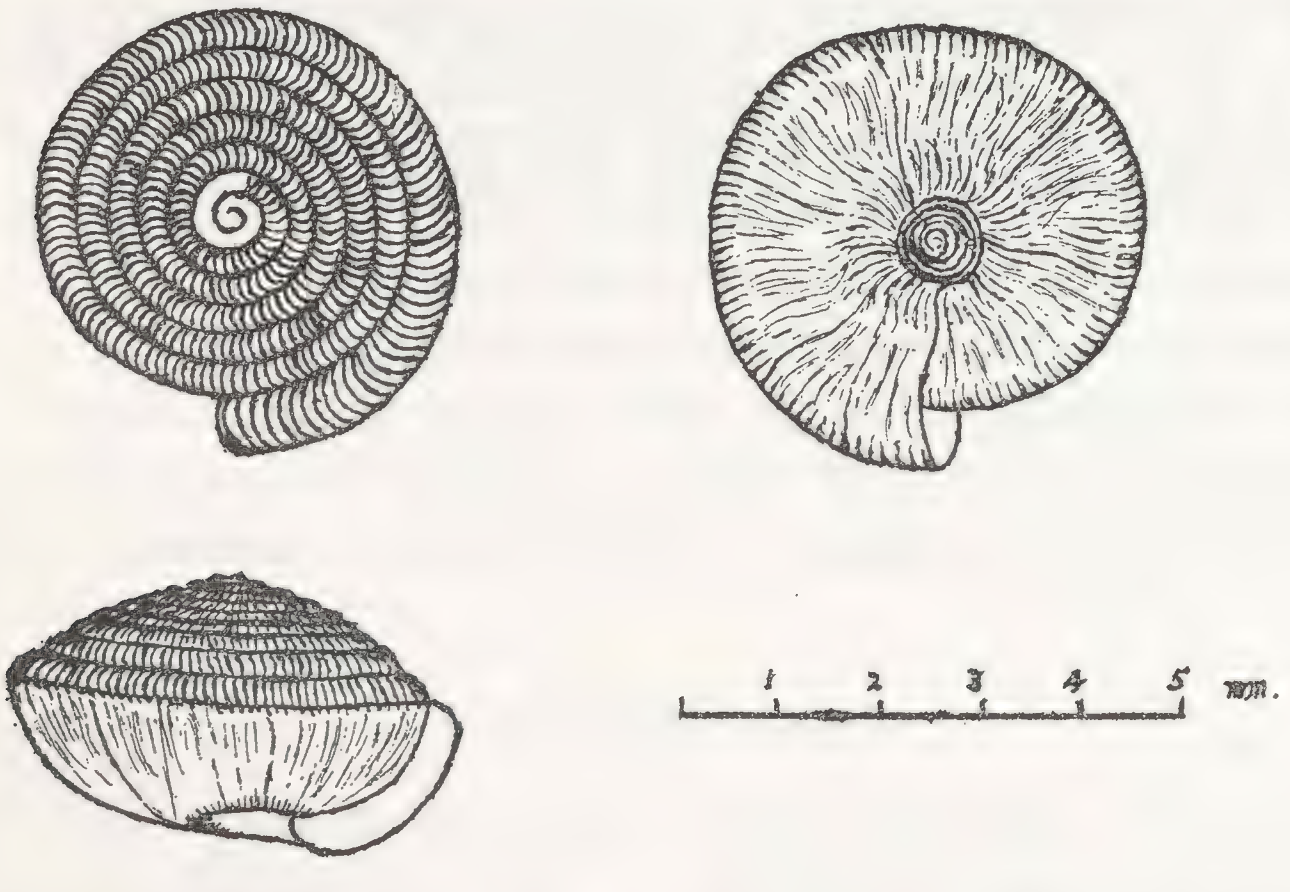

Fig. 1. *Imperturbatia levieuxi* (Nevill & Nevill). Silhouette Island, Seychelles.

Nevill & Nevill (1871: 6) described this species, unfortunately without a figure, and this description was repeated by Pfeiffer (1876: 198). Martens (in

MARTENS & WIEGMANN, 1898) mentioned *I. levieuxi* again, with descriptions and figures of four other species new of the same genus, emphasized the indication of the height being greater than the diameter, and queried whether it might not be the young of some other species. SYKES (1909) mentions the species in a table of distribution and referred in the text to it being 'almost unknown'.

G. NEVILL is reputed to have presented his collection to the National Zoological Collection of the Zoological Survey of India, but inquiries have failed to discover any trace of the type-specimen, and the probability is that it was lost with much other material in the disastrous floods in Benares in 1943. Similar inquiries of Dr KILLIAS of the Berlin Museum and Dr ZILCH of the Senckenberg Museum revealed no knowledge of any other specimen of the species, but both these gentlemen are also of the opinion that the measurements were transposed in error.

In view of the rarity of the species, the record should be amended. With the kind consent of Mr LIONNET the specimen in question has been presented to the British Museum (Natural History).

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J. Conch. **26**: 388–409 (1971)

EPIPHRAGMS: SOME OBSERVATIONS

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(*Read before the Society*, 20 *May* 1967)

Epiphragms are the thin walls of dried mucus with which snails close their shells when at rest. Although they are such a constant feature of the pulmonates, they have received little attention from malacologists. This paper is not intended to be a comprehensive account of the subject, its purpose being to record certain findings and to stimulate further research.

The Greek verb 'φρασσειν' means 'to hedge in', so the term 'epiphragm' implies an outer wall or hedge. (The stone walls surrounding fields in northern England are referred to as 'hedges'.) Epiphragms are temporary structures formed for the protection of the dormant animals and are discarded or eaten when their creators wake. They are not related to opercula in origin, and seem to be confined to non-operculate snails. Water snails rarely make epiphragms; the only one which regularly does so in Britain is *Planorbis leucostoma* Millet, which aestivates behind a solid plug of white material similar in appearance to the 'pot lid' of *Helix pomatia* L., but of a different constitution.

There are three fairly distinct groups of epiphragms, as follows:

a—Thin membranous structures, composed chiefly of dried mucus, more or less clouded with embedded calcareous granules, e.g. *Helix aspersa* Müller, *Theba pisana* (Müller) (Fig. 1a, b).

b—Thick, porous, chalky plates with an inner lining of dried mucus, e.g. *Helix pomatia* (Fig. 2).

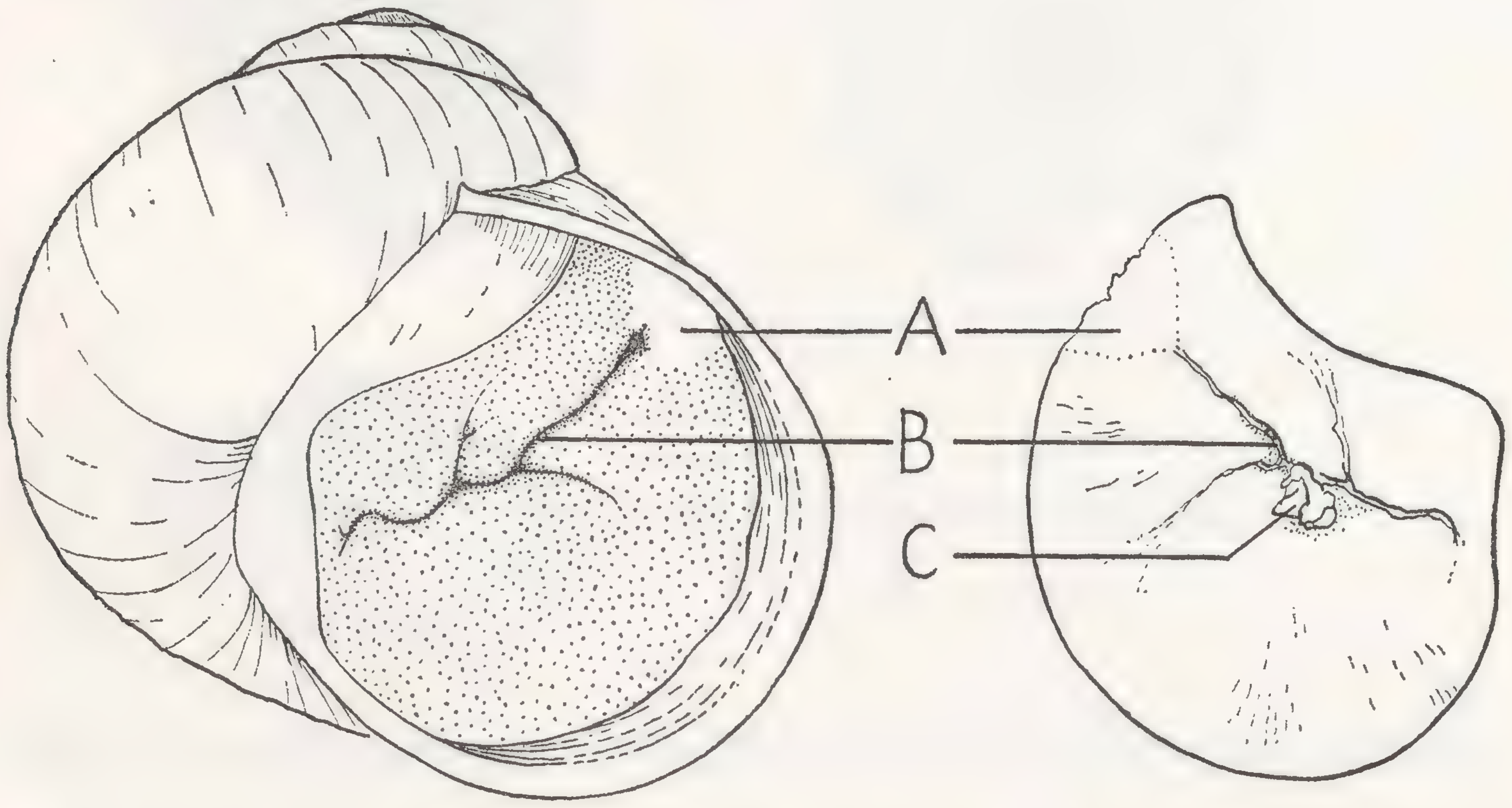

Figure 1. The dormant animal of *Helix aspersa* (**a**) compared with the inner side of its artificially removed epiphragm (**b**). **A** Calcium glands around the pulmonary aperture corresponding to the ventilator. **B** Junction of the chief folds of the mantle collar. **C** 'Starvation faeces'.

c—Thick or thin plates of shell-like material with an inner lining of dried mucus and a perforation in the region of the pulmonary aperture. Epiphragms of this kind seem to be diagnostic of the Achatinidae (Figs. 3a, b).

In membranous epiphragms there is a ventilated area in a position corresponding to that of the pulmonary aperture of the animal. In the membranous type it is a porous white patch, very fragile, often breaking of its own accord. This I have termed the *ventilator*. The thick, chalky epiphragms have the same kind of ventilator, but visible only on the inner (membranous) side, although it sometimes shows on the outer side as a slightly whiter spot. In the shelly epiphragms of the Achatinidae, the ventilator is an unobstructed perforation—usually a slit—passing through a short spout-like structure projecting from the inner side. When in use, the spout is fitted into the pulmonary aperture of the animal (Fig. 3b). Epiphragms of the North American Polygyridae which I have examined are exceptional in being quite devoid of any kind of ventilator, but they are extremely thin, so may be permeable enough for the needs of the animal.

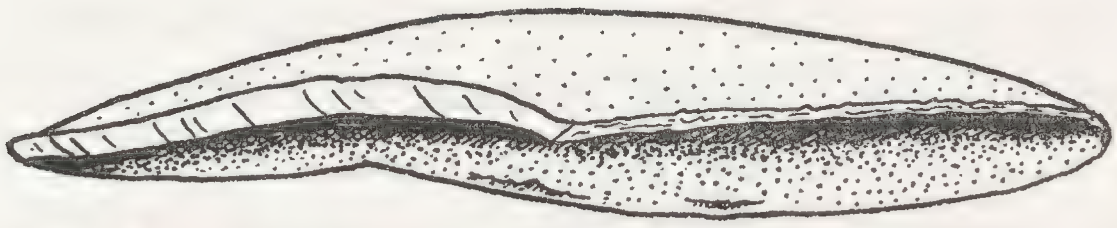

Figure 2. 'Pot-lid' epiphragm of *H. pomatia*; a view from the anterior edge showing the thickness and (uppermost) the domed outer surface.

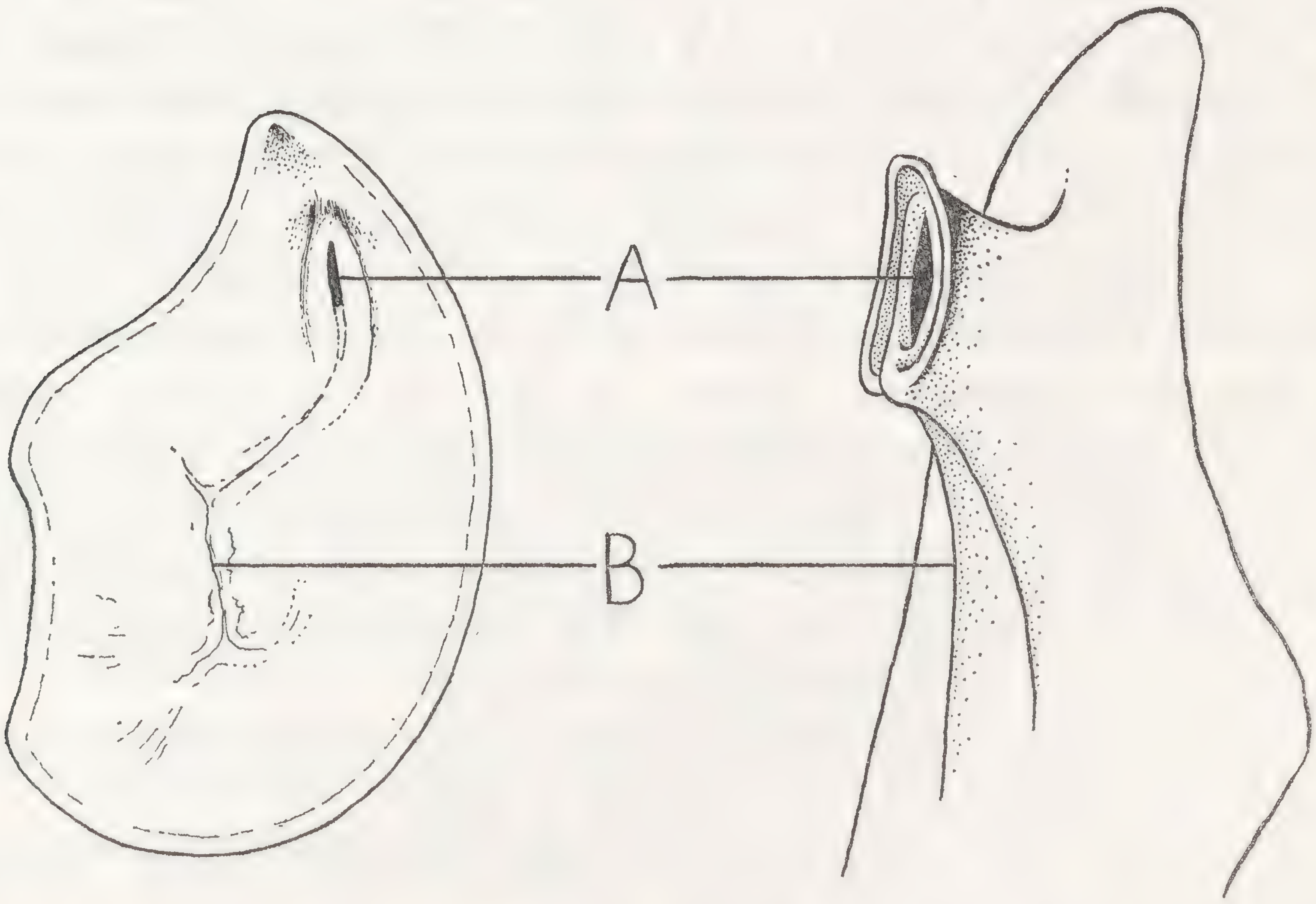

Figure 3. (**a**) Outer surface of an epiphragm of *Limicolariopsis* sp. (**b**) Detail of the inwardly-projecting spout of the ventilator of the same. **A** Aperture of the ventilator. **B** Ridge formed by the junction of the folds of the mantle collar.

CONDITIONS CAUSING EPIPHRAGM FORMATION

Epiphragms are formed when snails have just retired into their shells for a period of inactivity—hibernation, aestivation, or diurnal rest. The thickness of the structure formed appears to depend on the physiological condition of the animal, which is related to environmental conditions such as the ambient humidity, temperature, diet, etc. A seasonal factor may also be involved: *H. pomatia* forms a 'pot lid' epiphragm when it goes into hibernation in the autumn, but at other times it makes only a thin, transparent 'veil'. I have been unable to induce it to make a 'pot lid' at any other time of year. In other instances the thickness of the epiphragm depends more upon the environmental conditions prevailing at the time of formation, and on the condition, hereditary or acquired, of the individual animal. For example, *Helicella virgata* (da Costa) in Mediterranean regions forms a tough, opaque epiphragm, but when transferred to British conditions it forms transparent, thin 'veils'. Conversely, British examples subjected to long periods of warmth and drought in the laboratory produce the Mediterranean type of epiphragm. Under constant cool moist conditions, most kinds of snails either do not make epiphragms or make such thin ones that they tear as they dry. Dr C. R. C. PAUL tells me that about two dozen *Triodopsis multilineata* (Say) in his possession formed thin epiphragms, all of which split open, 'sometimes quite extensively', within three days of being secreted.

Generally, snails adjust the thickness and opacity of their epiphragms to temperature and humidity as described above in the case of *H. virgata*, but the capacity of different species varies in this respect. For example, *Cepaea hortensis* (Müller) responds to drought conditions merely by adding a little more lime to the epiphragm, so that it is scarcely different from normal, whereas *Cochlicella acuta* (Müller), under the same conditions, secretes a substance resembling plaster of Paris. The same applies in a lesser degree to individuals of the same species. Fourteen adult *H. aspersa* were exposed to the air at room temperature and observed daily for epiphragms. Within six days all had secreted epiphragms varying from delicate clear structures full of round holes to intact membranes with the appearance and toughness of white tissue-paper. When cleaned and exposed again, the snails repeated the performance, each one secreting the same type of material as it did the first time. The experiment was continued for six weeks, during which the following facts emerged:

1. The animals with dark-coloured mantle-collars always formed transparent epiphragms and were slow to do so (up to 14 days).

2. The animals with whitish mantle-collars secreted thicker, opaque epiphragms more quickly (up to 6 days).

3. Epiphragms formed 'in a hurry' (in an hour or two) were always transparent, regardless of the colour of the mantle-collar.

The whiteness of the mantle-collar is due to the calcium glands present therein, but I do not know whether the variation is due to the condition of the glands, or to their numbers, or both.

When the resting period is prolonged, further epiphragms may be formed to supplement the first one. These may be plastered on to each other, but are commonly separated by an air space. The number of supplementary epiphragms depends on the duration of the resting period: thus a group of *H. aspersa* which had hibernated for three months had three to six epiphragms each, whereas a solitary specimen which had been dormant for six months had sixteen. Apparently the supernumerary epiphragms mark a progressive loss in volume of the snail by desiccation and starvation, but raises the following questions: does duplication cut down water losses, or is it a form of excretion, or is there a certain optimum distance to be maintained between the animal and the epiphragm? The first two possibilities will be eliminated later in this paper, but the last cannot be supported as yet. HORA (1927) describes supernumerary shelly epiphragms in the achatinid *Glessula hustula* Benson, and BOBACK (1929) records examples of *H. pomatia* having two 'pot lid' epiphragms, but these are unusual cases. The duplication of thick epiphragms does not seem to be the rule, though I have noticed it in *Rumina* (an achatinid). Generally, any additional epiphragms are of the thin, membranous type.

Duplication has an interesting side effect: the more epiphragms a snail makes, the longer it takes to be reactivated. In a very dry site it may secrete a series of epiphragms which so isolate it from external humidity that it remains dormant until it dies, maybe years later. One *H. aspersa*, attached to my kitchen wall, showed no signs of movement for nearly a year, and was eventually removed by hand. It had a long series of epiphragms, which I regret were not counted. The removal of the epiphragms activates such a snail at once. The specimen of *Eremina desertorum* (Forskål) which revived after four years glued to a card in the British Museum (BAIRD, 1850) and the other cases quoted by COOKE (1895) would not have been mistaken for dead if their epiphragms had been removed.

It is not always clear what stimulus triggers the secretion of an epiphragm. The most frequently observed occurrence is the sudden retirement and sealing up of a snail when placed in a dry place, but a sudden rise of temperature can have the same result in a very humid conditions, and the stimulus for secreting supernumerary epiphragms is not known. HOWES & WELLS (1934) demonstrated that *H. pomatia* and certain slugs have rhythmical fluctuations in weight due to water loss (unconnected with feeding), and that the animals tend to aestivate when the weight is low. The key to more than one problem may lie here.

Even very young snails secrete epiphragms. Some eggs of Limicolaria were inadvertantly allowed to dry up. When broken open they were found to contain well-developed embryos, each with a perfect epiphragm, and all alive.

FUNCTIONS OF THE EPIPHRAGM

The possible functions are:

a—Protection from predators and pathogens.
b—Protection from mechanical injury.
c—Attachment to the substratum.
d—Prevention of desiccation
e—Excretion.

The fact that they seal the mouth of the shell means that they must fulfil the additional requirements of:

f—Respiration.
g—Sensory communication with the environment.
h—Resistance to decay.

PROTECTION FROM PREDATORS AND PATHOGENS. The armour-plating effect of thick epiphragms is so obvious that nothing needs to be said about it. On the other hand, thin epiphragms are no barrier to robust enemies like ground beetles, whilst the glow-worm is said to be able to inject its digestive juices into its victims through the epiphragm. Probably the snail's chief defence is its ability to smother its assailants with frothy mucus. The epiphragm secretion, however, greatly reduces heavy infestations of parasitic mites. One can see these pests running about on a still wet epiphragm, vainly seeking the glazed-over pulmonary aperture. When the mucus is dry, the mites quickly die. Dr GLENN WEBB tells me (*in litt.*) that he reduces mite infestations in his snail cultures by deliberately aestivating them, a ruse which I have adopted with partial success. Mites seem to be more numerous on sickly animals.

PROTECTION FROM MECHANICAL INJURY. There is probably not much protective value in thin epiphragms, but the solid 'pot lids' of *H. pomatia* and its allies appear to be constructed on sound engineering principles. These snails hibernate buried a few inches in the soil, lying with the mouth of the snail facing upwards. In time the gradual collapse of the overlying soil would press down upon, and eventually burst, a flat epiphragm; but in this case the epiphragm is slightly domed, so that all pressures are transmitted evenly to the strong supporting shell (see Fig. 2). It requires quite surprising force to break through these domed epiphragms when *in situ*, but when removed they crush easily. The effect is similar to that seen in a half egg-shell; when inverted in an egg-cup it is difficult to break, but collapsed with little pressure when laid on a flat surface. The shelly achatinid epiphragms are not usually domed, and the snails lie mouth-downward in the soil. I hope eventually to obtain comparative figures to illustrate the mechanical effects of doming, but as yet I have been unable to obtain enough experimental material. The 'pot lids' of *H. pomatia* are not always domed, so the above remarks should be treated with caution. The doming reflects the bulging of the mantle-collar, a sigh that the snail has absorbed the maximum amount of water. Other xerophilous snails bulge in the same way, but their epiphragms are not domed. This is probably because they secrete more mucus than calcium, resulting in more contraction on drying, thus stretching the epiphragm flat.

ATTACHMENT TO THE SUBSTRATUM. The epiphragm is often used as a means of attachment to various surfaces. This is an important function for three reasons. Firstly, snails are often trapped in high, exposed places by the rising sun. It is dangerous for them to release their hold and drop, as this may fracture the shell. (One *H. aspersa* in my possession actually dislodged its columellar muscle by falling less than a foot, and eventually came right out of its shell!) Secondly, there is a possibility that *Theba*, *Cochlicella*, and other snails which aestivate on posts, etc., do so in order to escape from ground dews which would reactivate them at times when there is little opportunity to feed, resulting in wasteful loss of energy, which could lead to earlier starvation. Thirdly, I have found that *Theba pisana* (Müller) and *Helicella virgata* fail to breed if they are not subjected to a certain (undetermined) period of sunshine just prior to the breeding season in early autumn.

However closely the mouth of the shell is applied to the substratum, there is always a ventilator. There is room for it near the angle formed by the junction of the upper edge of the lip and the adjacent whorl. This being the weakest part of the epiphragm, accidental tearing away of the snail from its support begins here. To form an attached epiphragm, the snail withdraws the head and front part of the foot, simultaneously expanding the mantle-collar. The shell is then drawn up close to the substratum, and the collar is pressed into the small space between them. This position is held for a period varying from a few minutes to several hours, after which the collar is withdrawn, leaving a thin band of mucus in its place. The natural tenacity of the mucus is enough to hold a small snail in place, but the foot retains its grip until the mucus dries, often for some days after it is dry. The process is easily observed in snails aestivating on the sides of glass jars. The shelly epiphragms of *Achatina* are sometimes attached, but in a different way. The centre of the epiphragm is extended to the substratum instead of the edge, thus forming a tubular pedestal or stalk (Fig. 4). This has been well described by WILLIAMS (1951), but his photograph is not very clear. Probably the tubular pedestal represents the folding of the mantle-collar around the posterior part of the foot, which would be necessary to support the heavy animal until the epiphragm hardened. I suggest the following explanation for the height of the pedestal: since the foot of a retracted *Achatina* is folded longitudinally and lies sideways in the mouth of the shell, considerable extension of the posterior part would be needed to allow sufficient of the sole to be unfolded and in contact with the substratum. The pedestal represents the central, partly folded foot.

Snails which normally aestivate above ground level, e.g. *Theba pisana*, may be so strongly attached to the substratum that the force required to dislodge them is more than enough to break the shell. The epiphragms of this species are as solid and white as those of *H. pomatia*, and persist on the desert scrub for years.

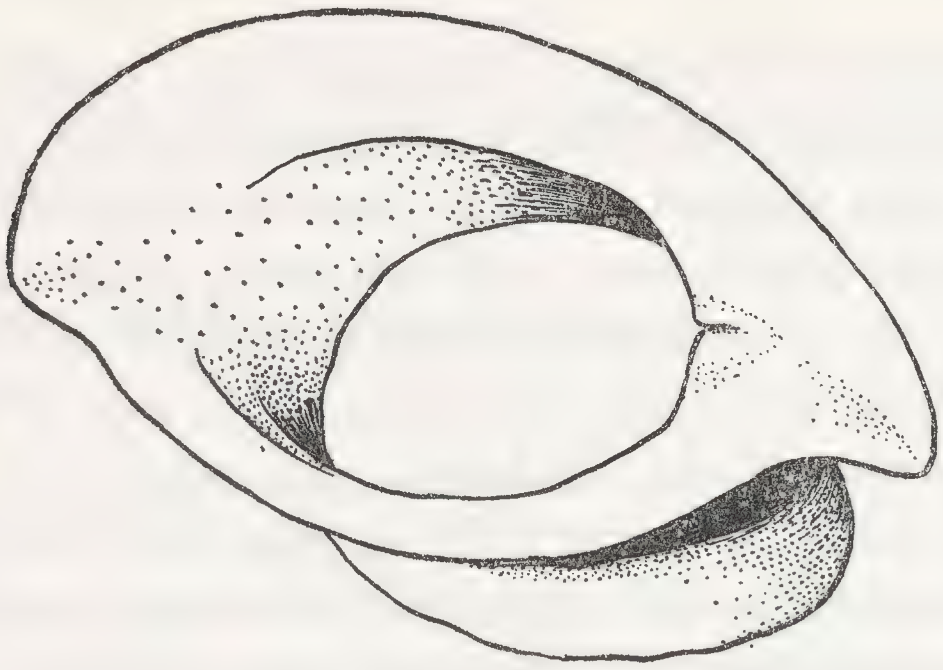

Figure 4. Attached epiphragm of *Achatina*, showing 'pedestal'. (Sketch based on a photograph by F. X. Williams.)

Prevention of Desiccation. The presence of a ventilator in most epiphragms, and the ease with which the thin ones are torn, suggests that at least some loss of water by evaporation cannot be prevented. In addition, the epiphragm is able to absorb water from the air, so that water transpired by the snail will dissolve into one side, pass through it, and evaporate from the other side. (The hygroscopic nature of a very thin epiphragm is easily demonstrated by breathing on it. Absorbing water from one's breath it relaxes, and rapidly becomes taut again as it dries out. The same effect is seen in a cellophane jam-pot cover, but an epiphragm is more sensitive.) The ease with which water passes through a thin epiphragm became apparent in the respiration experiment described on p. 396 of this paper. In this experiment, five *H. aspersa* were enclosed in a glass tube, arranged in a row, and chemically-dried air was passed slowly through the tube for twenty-four hours to deactivate them. After four hours, the one nearest the inlet was completely contracted and epiphragmed; the next had formed an epiphragm but was not contracted; the third was in the process of secreting an epiphragm; the fourth merely had its head tucked in; and the last, farthest from the inlet, was fully expanded and trying to escape. After eighteen hours there was little change, except that a little condensation was forming on the glass around the fourth and fifth snails. As the flow of air was considered to be quite sufficient to dry out the tube and snails in two or three hours, the only explanation is that the first three snails were exhaling enough water vapour through their epiphragms to activate the two snails 'down wind' from them. When the air flow was increased, the condensation dried up and the last two snails formed epiphragms in three-quarters of an hour.

It appears, then, that thin epiphragms have little effect upon water loss, a fact which has been abundantly demonstrated by the work of BURTON (1966), MACHIN (1966, 1967), FISCHER (1950), GABHARD-DUNKEL (1953), POMEROY (1966), and others working on the weight-losses of dormant snails with and without epiphragms. They all agree that the presence or absence of an epiphragm has little or no effect on the rate of water loss, that active snails lose water more readily than dormant ones, and that the rate of loss is very small for living dormant snails, but very high for dead ones. They suggest that the living snail has an unknown mechanism by which it retains water, which may involve the use of energy, as it ceases to work on the death of the snail. My own experiments in this field were inconclusive, but corroborate some of the published data.

Another point that emerged from POMEROY's (1966) work on *H. virgata* was that weight loss during dormancy is not uniform, but starts with a 'jump', and is punctuated by further jumps at irregular intervals, some at least of the irregularities in his graphs being correlated with short periods of activity. As snails commonly eat their epiphragms when reactivated, there is no means of telling whether the jumps in the graphs represent the occasions which, in certain species, lead to the formation of a series of epiphragms. The question which needs to be answered is, do the animals secrete epiphragms every time they are about to go dormant, or do they wake from dormancy to fulfil an unexplained physiological need to secrete an epiphragm? The occasional presence of faeces between adjacent epiphragms could provide an answer.

EXCRETION. It is possible, but hard to establish, that epiphragms are a form of excretion. The usual excretory materials—uric acid and its derivatives—seem to be absent from them, at least in the case of *H. aspersa*, which provided the epiphragms for my tests. Phosphate is another common excretory substance, and this was indeed present in the epiphragms of *H. aspersa* and *Limicolaria* sp. I tested, but only in small traces. Excretion is unlikely to be an important function of the epiphragm, however, since it is so often eaten after use. CAMPION (1961) states that calcium is extruded from the calcium glands of the collar (of *H. aspersa*) as carbonate, but suggests that it is transported to the glands as phosphate, whilst GROVE & NEWELL (1966) state that in *H. pomatia* the epiphragm consists of phosphates at first, which are later replaced by calcium salts, so the traces of phosphate in the epiphragms tested may have been only the residue of the process by which calcium was transported there. None the less, there may be an indirect connexion with phosphate excretion, as shown by the action of ultraviolet light. It is not unusual to find a small coil of faecal matter stuck to the inside of an epiphragm (Fig. 1b C). This is not the usual rectal contents, as it consists of whitish, granular, mucoid matter (similar in composition to the 'sausage-skin' covering of tenacious mucus which envelopes the usual faeces), without any fragments of plant tissue or brown pulp in it. It often contains discarded fragments of the radula. It probably represents the continuous outpouring from the intestinal lining and digestive gland which, during periods of normal activity, would be mixed with the ordinary faecal matter. I call it 'starvation faeces'. Under ultra-violet light, starvation faeces fluoresce brilliantly pale yellow (less so when dry), a characteristic of phosphates. The epiphragm itself fluoresces only faintly, and with a more bluish colour in most cases, attributable to calcium carbonate. *H. aspersa* is exceptional, its epiphragm fluorescing pale gold. The collar of the living animal of this species fluoresces brilliantly pale yellow, the intensity in different animals being proportional to the density of calcium glands. Mucus scraped from the collar is like liquid fire under the UV-lamp, and remains so when dry. So much yellow fluorescence suggests abundant phosphate.

It was noticed that snails of the same species from different localities formed epiphragms tinted with different shades of yellow, orange and brick-red, according to their origin. When subjected to ammonia vapour, the colours deepened markedly, a characteristic of the plant pigments known as flavones. CAMPION (1961) reported pigment glands in the mantle of *H. aspersa*, and showed experimentally that the amount of pigment contained is related to the diet, snails fed on green leaves having more pigment in the glands than those not given fresh plant food. She identified the pigment as a flavone. Probably other pigments are also present. I find that *H. aspersa* imported from Mediterranean regions most frequently secrete deeply pigmented epiphragms, and continue to do so for two or three weeks after introduction to a diet consisting chiefly of rolled oats; but the colour of each successive epiphragm is paler than the last, eventually becoming light horn colour. Since animals are not known to produce flavones, these were almost certainly ingested with the food, and can therefore be regarded as excretions.

RESPIRATION. Experiments were designed to compare the relative permeabilities of the porous ventilator and the non-porous areas of *H. aspersa* epiphragms gases. The chief difficulty lay in dealing with the ventilator, which is too fragile to handle, so although I was able to determine fairly accurately the permeability of the non-porous area, that of the ventilator could only be very roughly calculated. To measure the permeability of the non-porous area the following apparatus was constructed.

Two small plastic hypodermic syringes were drilled through their rims so that they could be bolted tightly together, mouth to mouth (plungers removed), the nozzles pointing in opposite directions (Fig. 5). The needles were converted into stoppers by blocking them with wax. An epiphragm was fixed between the two syringes as they were bolted together, thus separating the two chambers and making an airtight joint. The epiphragm had to be soaked in water first to make it flexible. One compartment was then filled with carbon dioxide and stoppered; the other was left full of atmospheric air, and the nozzle fixed so that it dipped into strong caustic soda solution. It was assumed that any carbon dioxide diffusing through the epiphragm from the upper compartment would be replaced by an equal volume of air diffusing in the opposite direction. The absorption of carbon dioxide from the lower compartment by the caustic soda caused a loss in volume which sucked up the caustic soda into the syringe, where the volume was read off directly from the graduations on the syringe. The experiment was allowed to run for a week, readings being taken twice a day.

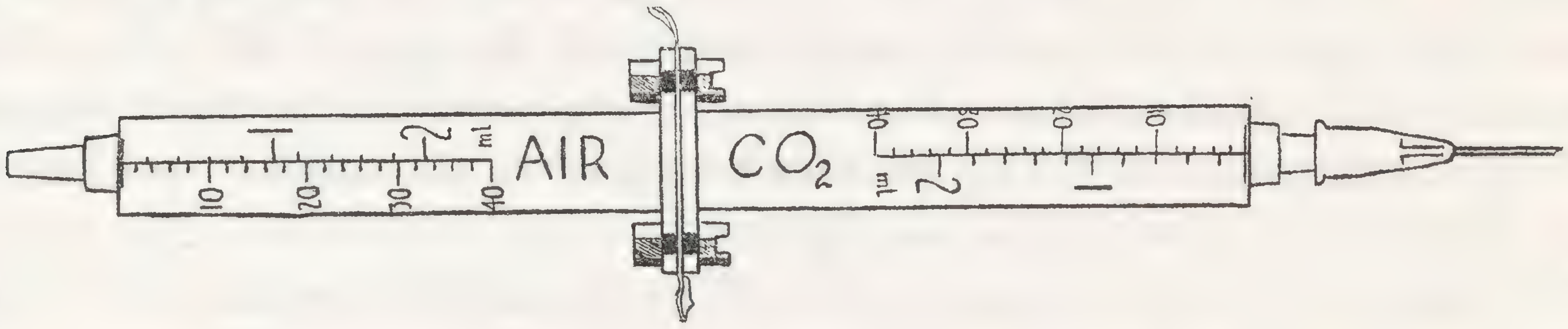

Figure 5. Apparatus for measuring the permeability of membranous epiphragms.

There was little result for 24 hours, after which the liquid rose steadily at a rate of 0·05 ml per day, which is very slow. The area of the disc of epiphragm across which the gases diffused was 57 mm^2. The area of an average-sized *H. aspera* epiphragm, calculated on a grid, is approximately 250 mm^2, which at the above rate would be capable of exchanging 0·215 ml of carbon dioxide and air per day at room temperature, *if it lacked a ventilator.*

In order to establish how far this figure coincided with the requirements of the living snail, and to compare it with what passes through the ventilated epiphragm, the amount of carbon dioxide expired per day was measured as follows.*

A small aerator pump was used to pass a constant flow of air through (a) concentrated caustic soda solution to remove any carbon dioxide present, (b) concentrated sulphuric acid to dry the air, (c) a respiration chamber consisting of a 1½″ diameter glass tube, with some soda-lime at the intake end to remove any acid fumes and to complete the air-drying, and finally (d) a 1 cm diameter glass tube into which barium hydroxide solution could be introduced by means of a pipette. This tube was arranged at an angle near to horizontal, so that bubbles of air passing through the solution would do so as slowly as possible, thus giving ample time for the barium hydroxide to be precipitated by the carbon dioxide exhaled by the snails. Five adult *H. aspersa* were placed in the respiration chamber, and the air flow adjusted to a slow, steady stream. In due course the snails responded to the dry air by forming epiphragms, and the experiment was then started. 20 ml of 0·1 N barium hydroxide solution was then introduced into the narrower tube, and air passed through the apparatus for one hour, after which the carbon dioxide absorbed was determined by titrating the residual barium hydroxide with 0·1 N hydrochloric acid (1·0 ml of acid = 1·119 ml of carbon dioxide). A number of hourly samples were taken, and the average carbon dioxide output calculated. It was found that at an average temperature of 22° C, the snails were expiring an average of 5·97 ml of carbon dioxide per snail per day, through intact epiphragms. This is approximately twenty-seven times as much as the figure calculated for a hypothetical non-ventilated epiphragm. It must be remembered that, in the previous experiment, pure carbon dioxide was used, which would greatly accelerate the rate of diffusion. These figures are very much open to question, but it is obvious that even a very gross error in technique or calculation would be unlikely to account for such an enormous discrepancy between the two figures.

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* Actually, carbon dioxide diffuses more slowly than air, but the readings of this experiment were so constant as to indicate that some kind of equilibrium had been set up, probably due to pressure changes in the upper compartment.

The amount of carbon dioxide given off by epiphragmed snails in the above experiment should not be taken as representing the respiration of dormant snails. Pomeroy (1966) has shown that snails do not become fully dormant until about a week after secreting the epiphragm. A fully dormant snail would produce extremely little carbon dioxide, and would then have no need of a ventilator if the epiphragm was thin; in fact, one cannot rule out the possibility of anaerobic respiration, as has been demonstrated by Meenakshi (1957) in *Pila virens* (Lamarck). It is reasonable to assume, however, that the ventilator is needed for a short time at the commencement of diapause. How the Polygyridae manage without one I cannot say, but those epiphragms I have examined have all been extremely thin, and probably quite permeable.

Sensory Communication with the Environment. There does not seem to be any one factor which is primarily responsible for the activation of resting snails, and the conditions needed to cause activation vary according to whether the animals are hibernating, aestivating, or merely resting. Temperature changes, increased humidity, and pressure changes all seem to play a part in varying degrees. This subject needs to be comprehensively surveyed in a large number of species under controlled conditions before any rules (if there are any) can be laid down. Just how the epiphragm affects aestivation is not clear, except that it forms a barrier which slows down the penetration of activation stimuli, as shown by the prolonged dormancy of snails with many epiphragms, and the very rapid activation that takes place when epiphragms are artificially removed. Throughout this paper it is evident that epiphragms are of little use for the functions suggested for them, but here may be the whole reason for the secretion of these problematical structures. Can it be that by filtering out small stimuli ('false alarms') epiphragms prevent activation at unseasonable times, thus preventing waste of energy? The thickest epiphragms are formed in times of excessive heat, cold or dryness, i.e. the most dangerous times when it is most important that the animals should not emerge. The air-space left when the animal contracts away from the epiphragm would further insulate it against the environment.

It is possible that the non-attached drum-head type of epiphragm could act as a kind of hygrometer, or transmit vibrations like an ear-drum, and quite often there is a direct connexion between the animal and its epiphragm. This was described by TURTON (1831) thus: '. . . in the centre of this epiphragm (of *H. pomatia*) is an exceedingly minute orifice, communicating with an umbilical chord, which is connected with a fine placenta-like tissue of vessels penetrating into the pulmonary cavity itself. And this minute orifice . . . is of sufficient capacity for the passage of that quantity of oxygenated air necessary for the purpose of extremely slow but not totally extinct respiration. If this orifice be covered over with a coat of wax or varnish so that all possible connection with external air be excluded, animal life becomes altogether extinguished, never again to be restored.' This rather fanciful dissertation concerns a kind of tail arising from the centre of the epiphragm, and passing across the air-space to the animal, where its somewhat expanded end is lodged among the folds of the mantle collar (but not, as far as I have been able to ascertain, into the mantle cavity). I have yet to see TURTON's 'minute orifice' and 'placenta-like tissue of vessels'! I have called this structure the **arista** from the Latin word implying an awn or 'beard', as on a barley grain (see Figs. 6, 7).

The arista is usually lost when the epiphragm is removed but, once the worker

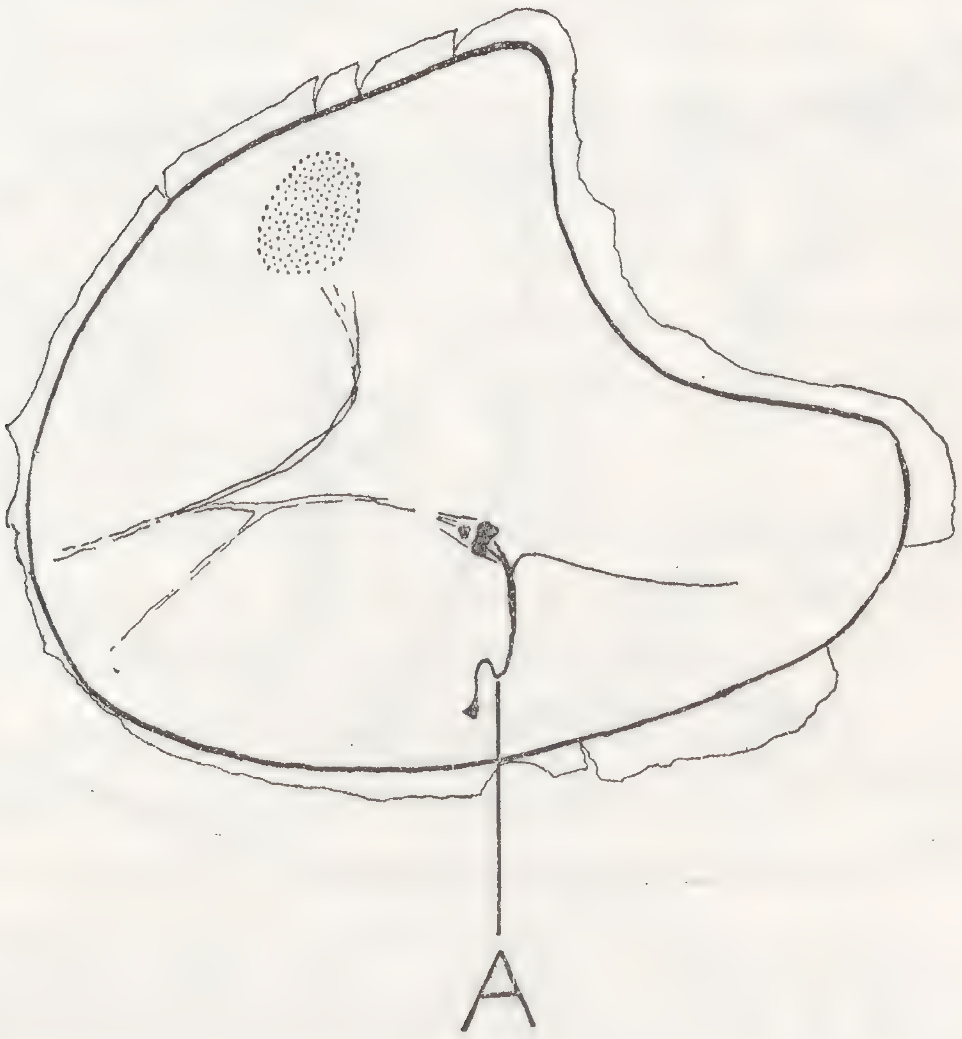

Figure 6. Inner surface of an epiphragm of *Cepaea hortensis*, showing the arista (**A**).

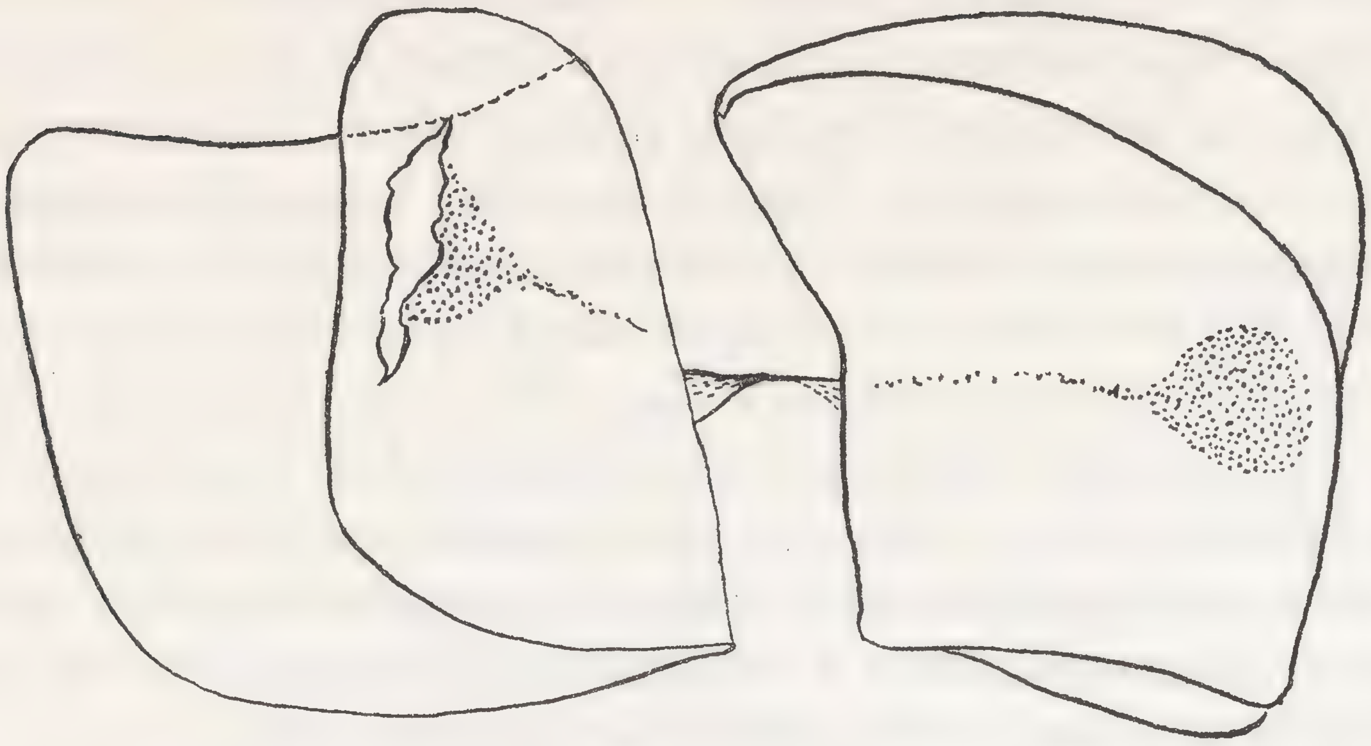

Figure 7. Two adjacent epiphragms of *Alabastrina* sp., folded to show the connecting arista.

is aware that it could be present, very little care is needed to preserve it. If there are several epiphragms present, they may all be connected together by the aristae. One rarely finds the arista connected to the snail as described above, as it pulls out of the mantle if the animal withdraws too far into its shell when disturbed. In order to see the connexion, the body-whorl of the shell must be clipped away as shown in Fig. 8. *Cepaea hortensis* is a good subject for this

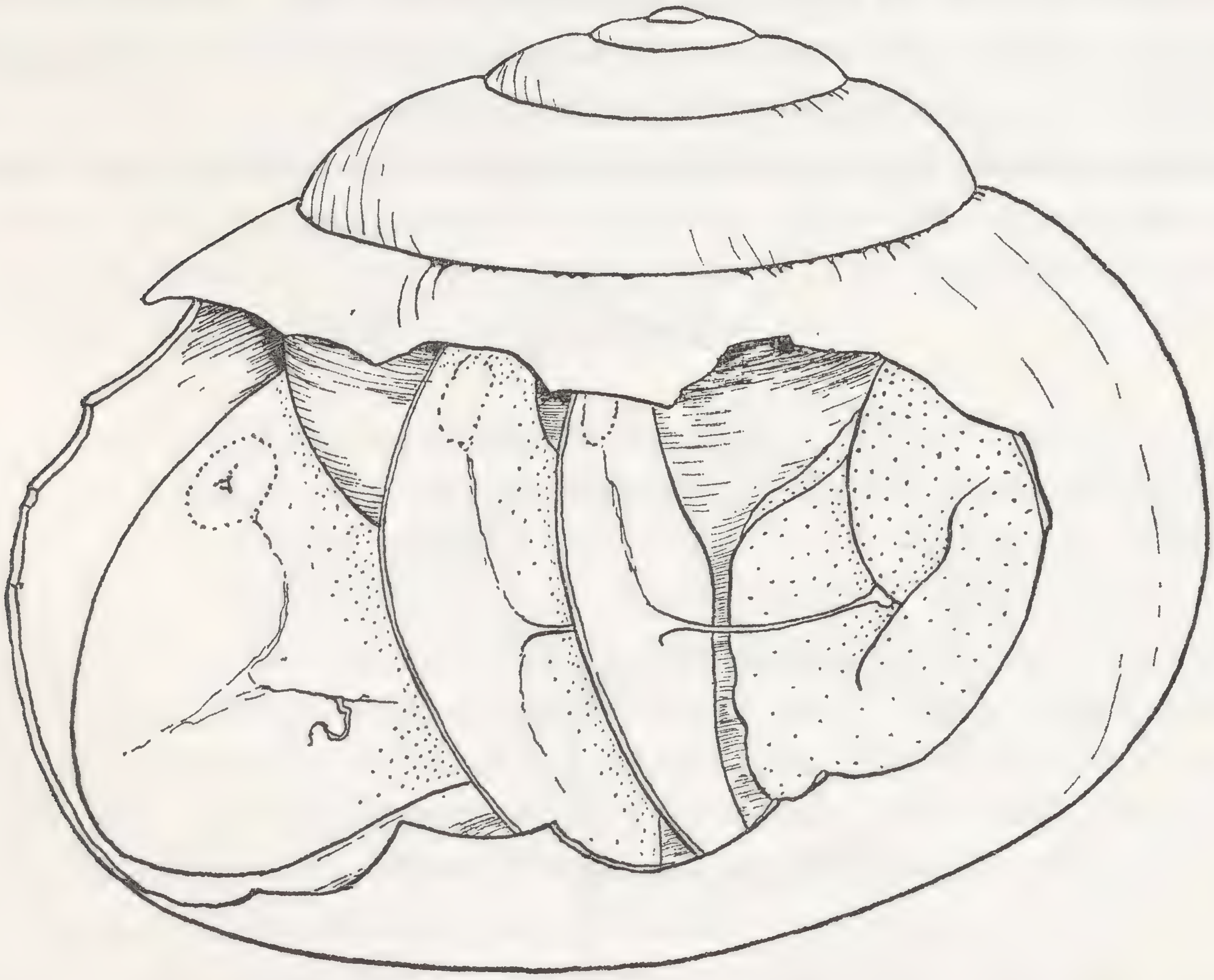

Figure 8. *Cepaea hortensis* after six weeks' aestivation. The shell has been cut away to show three consecutive epiphragms. That on the left has lost its connexion with its neighbour. The other two are connected by aristae, and an arista is seen passing into the folds of the mantle of the living animal on the right.

experiment, the arista being almost always present. It is soft and wet near to the animal, so that it may sag as shown in the drawing. This softness is probably due to the absorption of water from the animal, but could be due partly to a different chemical composition. That the arista is chemically distinct from the body of the epiphragm can be demonstrated by staining with eosin Y and methylene blue. The former is an acidic dye which is fixed by basic substances, and the latter is a basic dye which is fixed by acidic substances. On soaking in alcohol, the dyes are dissolved out, except where they have been fixed. By this method the epiphragm stains red (eosin) and the arista blue, with darker streaks in it. The arista is therefore composed of a compound more acid than the rest of the epiphragm. The fact that it is composed of a different material, that it often connects epiphragms to the animal and to each other, and the frequency with which it is formed by certain species suggests that the arista has a proper function; on the other hand it may be the useless final stage of secretion when the last drop of wet mucus is drawn out, quite fortuitously, into a thread as the animal draws back. The arista remains projecting like an antenna from the epiphragm, so that even if the animal does release its hold on it, it will be the first point of contact with the epiphragm when the animal advances.

If the epiphragm is indeed a filter for checking minor stimuli, then its effectiveness must depend upon its permeability, which must in turn depend upon the size and number of the pores in the ventilator. Although the slit-like ventilator of the achatinid epiphragm occasionally features in the literature, I have not come across a definite statement that the porous ventilators of helicid epiphragms are in fact porous. Pores are, however, difficult to see under the microscope without previous treatment with silver nitrate solution. This penetrates rather slowly, so that with a few seconds' immersion, only the corners and edges of holes and projections are stained. This throws the edges of the pores into sharp relief, so that the beginnings of their tortuous passages through the ventilator are clearly visible. The silver nitrate must be washed out of the preparations with changes of distilled water for several hours, otherwise they become uniformly black. If a well-epiphragmed snail is placed in warm water, the expanding air in it is seen to escape slowly through the pores, but it is easy to be deceived in this, as the ventilator is often cracked.

The actual size of the pores can be only approximately measured, as they are irregular in shape and only moderately uniform in size. Some samples of approximate diameters are: *H. aspersa* and *Eobania vermiculata*, 0·02 mm; *Cepaea hortensis*, 0·01 mm; *Alabastrina* sp., 0·002 mm. The way in which the pores are formed could be explained by analogy with concrete: just as concrete consists of stones embedded in a groundmass of cement, so the epiphragm consists of calcareous granules embedded in a groundmass of mucus. In badly mixed concrete there are patches where there is not enough cement to fill the space between the stones, so that air-spaces are left, through which water will flow freely. When an epiphragm is secreted, there is a high concentration of calcareous granules formed in the region of the respiratory aperture, with correspondingly less mucus. What little mucus there is contracts on drying, thus glueing the granules together, but leaving the interconnecting air-spaces between them.

RESISTANCE TO DECAY. Old epiphragms attached to the inside of plant-pots have survived the effects of bacteria, fungi and plant roots in the soil for periods of nearly a year in my greenhouse. In fact, rejected epiphragms never seem to decay at all, but are gradually nibbled away by mites, springtails, and other soil animals, or are eaten by the snails that made them. It would be interesting to discover the 'active principle' which makes them so resistant to decay.

The chief constituents of epiphragms are mucoproteins (forming the bulk of the mucus), a lesser amount of simple proteins, and calcium salts. Mucoproteins are fairly inert chemically, which may partly account for resistance to decay. There is slight dissolution of epiphragms in sodium sulphide, indicating the presence of a keratin-like substance. Sodium hydroxide, hydrochloric acid, sulphuric acid and tryptic enzymes, used one after the other, will almost completely destroy an epiphragm, but there is always a residue of amorphous protein left. Possibly this is conchiolin, which has a very long life. Mr TOM PAIN tells me that he has found intact epiphragms in fossil snails, and conchiolin remains almost unaltered in the oldest fossil shells, so it would not be remarkable to find that this substance is an important stabilizer of epiphragms.

The snail itself is curiously resistant to fungal attack. Dead snails are rapidly decomposed by bacteria, but a mouldy dead snail is rare. Mould appears only on desiccated corpses, and then it seems to be confined to the surface, probably feeding on substances diffusing out of the body or the products of bacterial decay. Occasionally one finds a snail which has died behind its epiphragm and become mouldy, but although the fungal hyphae may penetrate the ventilator pores, the substance of the epiphragm is unaffected.

CHEMICAL COMPOSITION AND ORIGIN

The epiphragm is the product of the mantle collar. CAMPION (1961) states that the epiphragm of *H. aspersa* is composed of protein with a little calcium. The 'mucoids' to which she refers in her paper are faintly Millon's-positive proteins containing a large proportion of carbohydrate units in the molecule, so that they are viscous like starch paste, an obvious advantage. Another more strongly Millon's-positive protein is also present as a ragged network in the mucoids, the two substances contrasting well in Millon's-treated epiphragms when viewed microscopically. It is fairly clear that they are the products of different glands in the mantle-collar, as CAMPION describes two kinds of mucus glands as well as protein glands in the collar of *H. aspersa*. It would be unwise to assume that both kinds of mucus glands contribute to the epiphragm, for CAMPION has demonstrated that several different kinds of mucus are produced as a defence, of which only one may be suitable for building purposes.

Under high-power magnification, the protein/mucus groundmass has the appearance of a mass of minute globules having a slightly higher refractive index than the substance between them, suggesting a near-colloidal structure. After treatment with dilute acid the globules have a slightly lower refractive index than what is between them. The globules are too large for colloidal droplets. Both components of the groundmass take up biological stains to the same degree, so they are probably the same substance, the globular texture being an optical phenomenon caused by strains set up in the solidification and drying processes. On the other hand they may be the elliptical bodies *c.* 5 μ long seen in mucus by KÜNKEL (1916) and PRENANT (1924). Eosin Y and various haematoxylins are suitable stains for the groundmass.

When stained with alizarin, the groundmass takes on a shade of red characteristic of calcium salts (as for example in bones). As crystalline calcium carbonate does not stain in this way there must be calcium dissolved in the mucus and/or protein, and probably other metallic salts, many of which will also 'lake' red with alizarin. The presence of divalent cations, especially those of calcium, have a stabilizing effect on mucoproteins. In the absence of calcium, intercellular cement and such proteins as mucin and gluten absorb water until they become completely 'dissolved' in it; when calcium ions are present in the water, they remain thick and jelly-like (GRAY, 1925). According to CAMPION, calcium is secreted from the calcium glands in a granular form, so either it dissolves in the mucus after secretion, or is already incorporated in the mucus before it leaves the mucus glands.

The most interesting components of epiphragms are the white calcareous granules which give them a more or less clouded appearance. Even apparently clear epiphragms contain a few minute granules, which show up in polarized light in the microscope as they are optically active. At the other extreme, the solid chalky epiphragms of *H. pomatia* are composed almost entirely of them. In size they range from 0·1 mm to material so fine that it can be regarded as crypto-crystalline or amorphous, and there appears to be more than one kind. They appear suddenly as the epiphragm dries, so they may not be the same granules as are extruded from the calcium glands, but they do consist of calcium carbonate, as they effervesce vigorously in dilute hydrochloric acid. In some rare cases they do not dissolve in acid, which may be due to protective coatings of protein, if they are not of a different substance. In her 1961 paper, CAMPION says that the calcium glands of *H. aspersa* contains granules of calcium carbonate 'suspended in a faintly yellowish matrix of basic protein', a possible origin for protective coatings. All the granules seem to be coated, but the coats are usually permeable to acids.

Microscopically, the granules are separable into six types:

1. Circular bodies with a clouded nucleus and occasional radial cracks, giving a flower- or wheel-like appearance (see Fig. 9). In some, the nucleus and cracks are negligible, so that a different kind of granule seems to be present, but the use of polarized light shows that they are only a variety of the normal kind. The nucleus sometimes takes up biological stains, showing that organic matter is present. Sometimes there are narrow circular zones between the nucleus and perimeter which take up silver nitrate, probably representing a discontinuity in the crystallization process (see Fig. 10). The general appearance of this type of granule indicates a radial aggregate of acicular crystals known as a druse, spherule or spherulite (though a spherical shape is unusual, since physical factors often interfere with regular growth). Spherules of calcium carbonate make up the egg-shells of snails, and are characteristic of the egg-capsules of certain aquatic Neritidae, where their different shapes form specific characters for identification (Andrews, 1935, 1937). The druse construction of the granules is shown by the effects of polarized light, which makes a cross-shaped shadow centred at the nucleus, owing to the crystals in two planes at right-angles being in extinction. They are strongly birefringent (i.e. showing rainbow colours in polarized light), suggesting that they consist of calcite or aragonite. They are

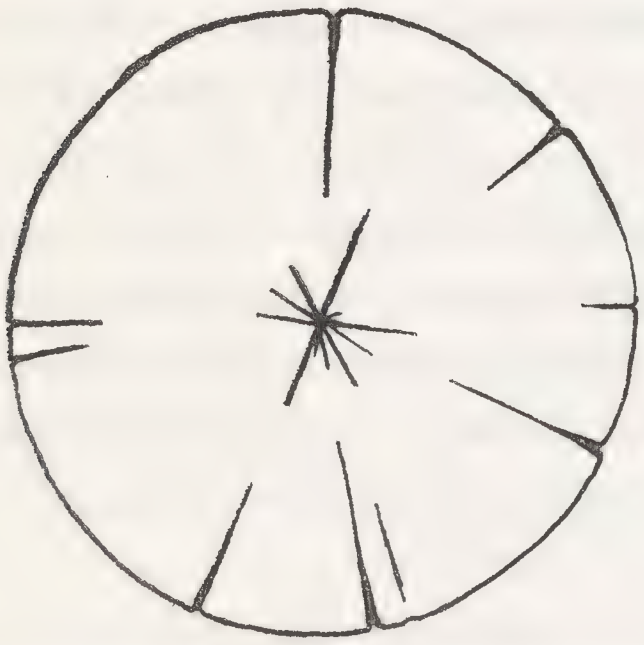

Figure 9. Circular spherulite of aragonite.

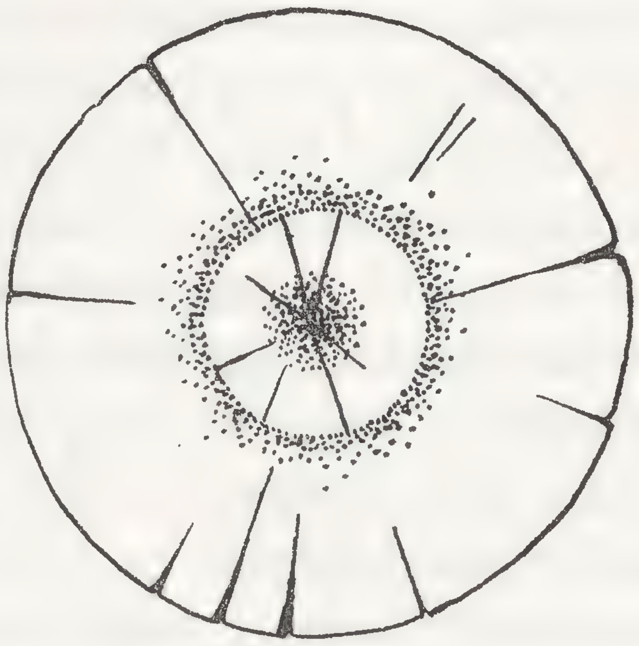

Figure 10. Zoned spherulite.

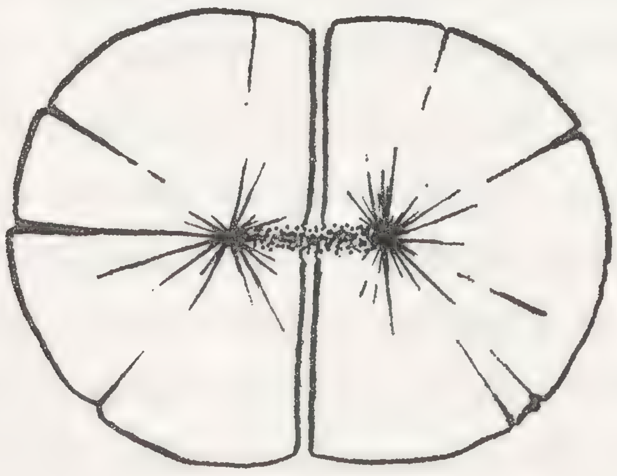

Figure 11. A 'dumb-bell'. Figs. 9, 10 and 11 are all from the same epiphragm of *Helix aspersa* in which the spherulites were unusually perfect. They are usually more or less asymmetrical.

not the unstable form known as vaterite, which has weak birefringence and dissolves readily in distilled water. They are flat, not spherical. In size they range from 0·1 mm in diameter downwards, and the dominant sizes are related to the size of the epiphragm. This is the commonest type of granule. Similar flower-like bodies appear on the surface of 'hard' water when heated, but these are not optically active.

2. Dumb-bell shaped bodies which are the same as the previous kind, but formed by crystallization about opposite poles of an elongated nucleus. Fairly common (see Fig. 11).

3. Fan-shaped bodies which are segments of the first type of granule (see Fig. 13**A**). In some cases, e.g. *Limicolariopsis elgonensis* Crowley & Pain, these segments are poorly matched in the circular granules, giving the appearance of heraldic roses with petals of unequal length, frequently with more than one row of 'petals', and obviously flat (see Fig. 13**B**).

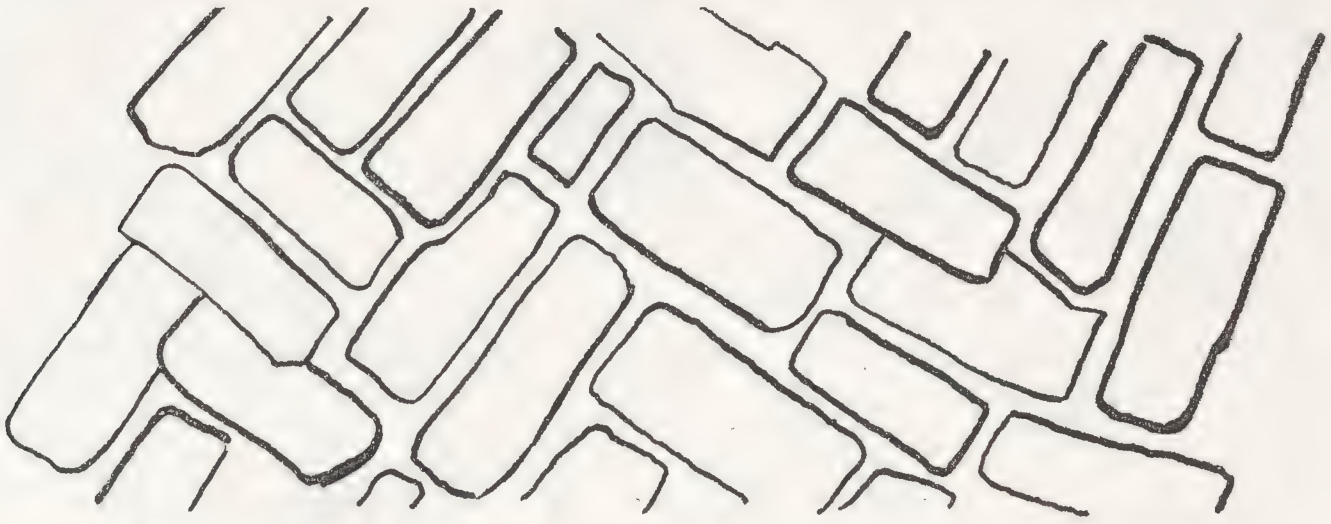

Figure 12. Aragonite flakes in 'parquet' arrangement near the ventilator of the epiphragm of *Cepaea hortensis*.

These first three types of granule are related by many intermediate forms.

4. Truly spherical druses of slightly yellowish crystals. These are very rare, obviously of a different material, and I have no idea what they represent (see Fig. 13**D**).

5. Long rectangular flakes with square or rounded corners, haphazardly arranged, but with a tendency to lie at right-angles to each other, like the blocks in a parquet floor (see Fig. 12). They are single, highly birefringent crystals of aragonite. They occur sporadically in drifts, often taking the place of the round granules in and around the ventilator, or may be absent in different individuals of the same species. They are common in *Cepaea*. They are under 0·1 mm long and a quarter or less as wide.

6. Cryptocrystalline matter, impossible to examine in detail. Unfortunately it has been impossible to obtain a satisfactory identification of all the granular material, as the mucus groundmass interferes with their optical properties, and all attempts to isolate granules for X-ray diffraction analysis have failed; they

always come out with a thin organic coating. When boiled with dilute cobalt nitrate, the granules in the epiphragms of *H. aspersa* and *Cepaea nemoralis* take on a violet-purple colour, showing that much aragonite is present (Meigen's test). With this treatment, calcite becomes sky-blue, but only if finely powdered; otherwise it remains white or colourless. Although I have sometimes imagined I have seen traces of sky-blue in tested epiphragms, it is difficult to be sure. Some of the very fine cryptocrystalline calcium remains white.

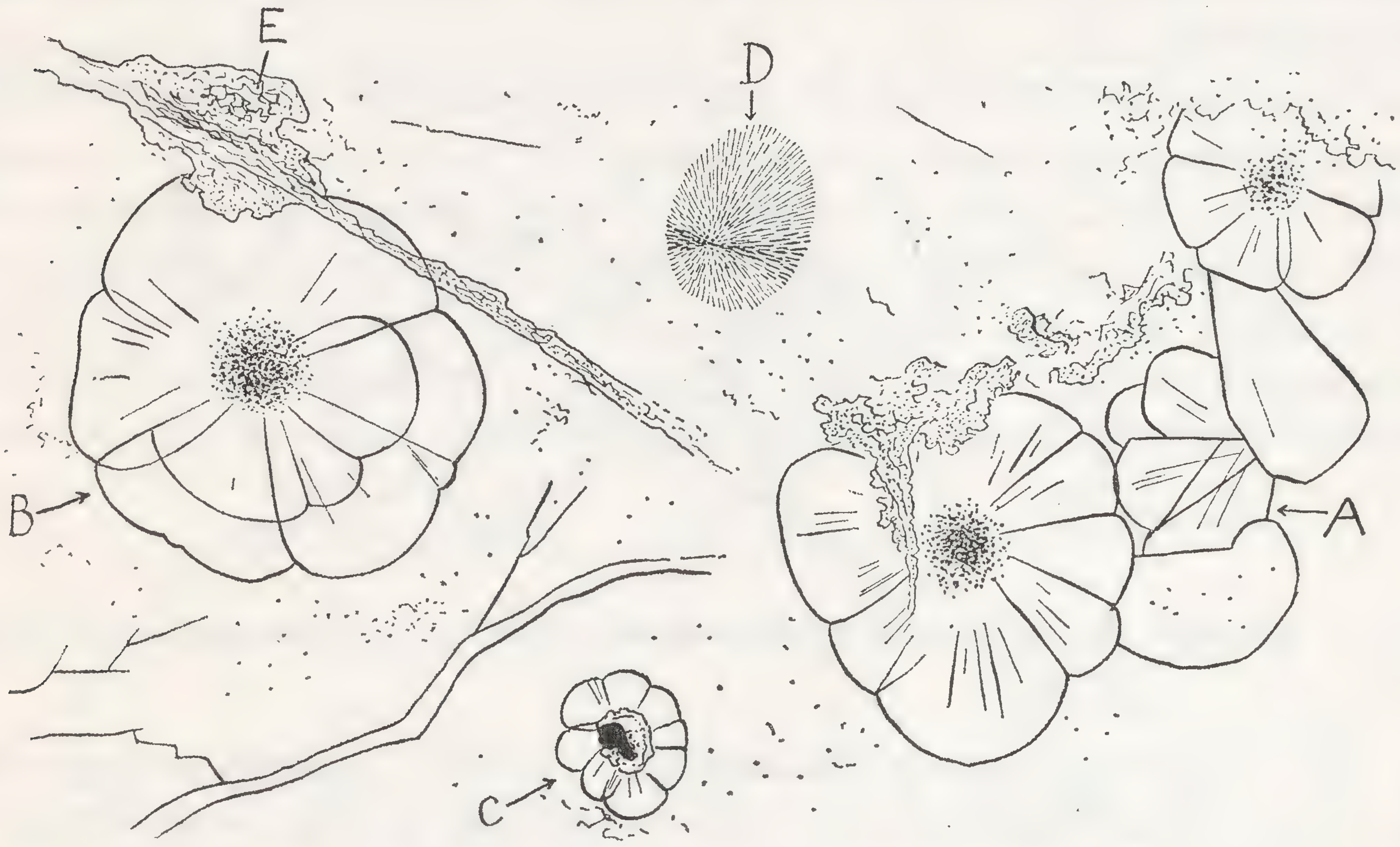

Figure 13. Sample of mucus secreted at the commencement of epiphragm formation by *Limicolariopsis*. **A** 'fans' or 'petals', **B** a 'rose', **C** a small 'rose' crystallizing around a fragment of dirt, **D** druse of yellow crystals.

The shelly epiphragms of the Achatinidae consist of an interlocking mass of crystals, very like the nacreous layer of shells (see Fig. 14). Meigen's test shows it to be calcite. The mantle-collar does not exhibit any calcium glands to the naked eye, and neither it nor mucus scraped from it are fluorescent. The crystals form slowly. All these facts indicate crystallization from an unsaturated solution, the condition which favours the formation of calcite. (Aragonite forms only in saturated solutions.) There is a definite laminated structure, layers of crystals alternating with layers of mucus. A few 'roses' and 'petals' may be found in the mucus, but their crystal form has yet to be identified.

The process of crystal deposition in epiphragms is probably similar to that involved in shell formation and regeneration. This has been the subject of several investigations, the results of which are summarized by WILBUR.

The high concentration of granules at the ventilator is correlated with the density of calcium glands around the respiratory aperture, at least in the species mentioned in this paper. The glands can be seen in the living animal, by the naked eye, as fine white streaks extending into the tissues from the surface of the mantle. If the light strikes the pulmonary aperture at a suitable angle, one can see the beating of a patch of cilia exactly corresponding to the area where the calcium glands are concentrated. I do not know the significance of this, but it is possible that the ciliary beat may in some way play a part in the formation of the ventilator.

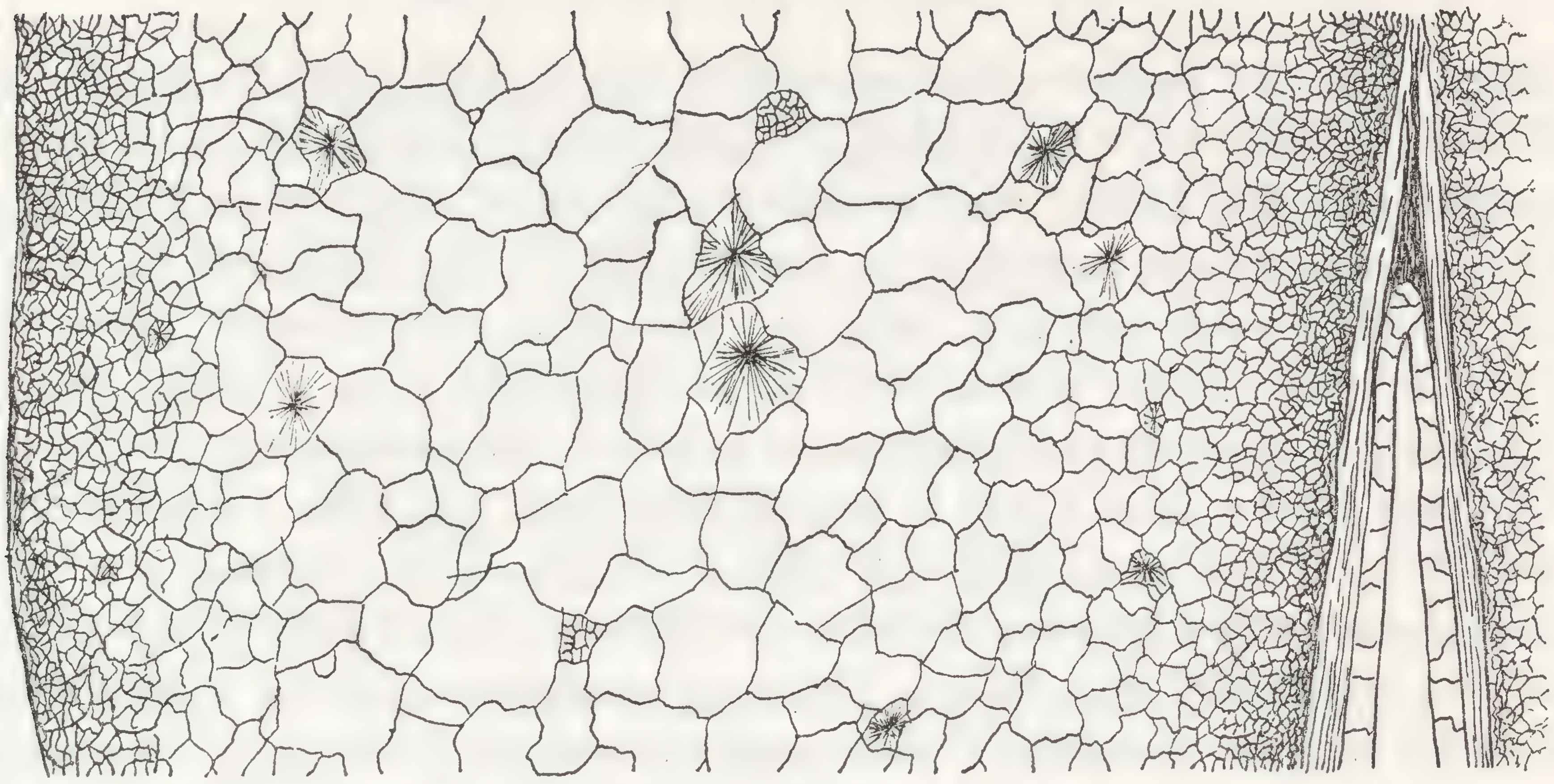

Figure 14. Section through an achatinid operculum.

Whilst it is wet, the inner surface of an epiphragm is an accurate mould of the collar, but it becomes distorted as it dries if it is not supported by abundant calcium. Even so, one can trace (in reverse) every little wrinkle of the collar, a slight bump (depression) at the pulmonary aperture, and a wavy ridge (groove) where the edges of the collar met (see Fig. 1a, b). Valuable clues to the anatomy of extinct species could be obtained from a study of fossil epiphragms. If the animal defaecates just before dormancy, the tip of the faecal coil is built into the centre of the epiphragm, thus preserving evidence of its latest diet. It is rare to find any but starvation faeces on the inside of an epiphragm, and these are always separated from the animal by another epiphragm. Ordinary faeces may be stored in the rectum for over a year, but do not decompose, a fact which I attribute to the decay-resistant properties of the sleeve of tenacious mucus which invests all snail faeces like a sausage skin. This substance resembles the mucus ground mass of the epiphragm in some of its properties: when fresh it dissolves easily in washing soda, but if allowed to dry it never softens again, even in concentrated hot caustic soda. Boiling dilute acid is more effective for softening hard mucus sleeves (a treatment which splits mucoproteins to reducing-sigars and inorganic sulphate). This suggests that an irreversible change takes place when this kind of mucus dries, which could be why desert snails such as *Theba* *pisana* can tolerate extreme overcrowding—their faeces are hermetically sealed and therefore safe. In damp places the mucus sleeves would not harden, and the habitat would soon become foul. The primary purpose of mucus sleeves would be to protect the rectum from harsh plant-fibres, but the secondary functions mentioned above probably have a survival value.

Disposal of the Epiphragm

The toughening process which takes place as an epiphragm dries makes it very difficult to remove unless it is soaked in warm water, yet the snail has no difficulty in pushing it off. Under very hot, dry conditions, *Theba pisana* makes epiphragms so tough that attempts to forcibly detach the snail only fracture the shell; yet the animal casts it as easily as a man takes off a coat. (These remarks do not apply to the shelly achatinid epipharagms which can often be dislodged with gentle pressure or even shaken out.) When a snail revives, it first wets the epiphragm with a clear liquid (? mantle secretion), and after a minute or two pushes it aside and eventually right off. Naturally-shed epiphragms are more fragile than those removed artificially, especially the shelly kind, which fall apart into thin wafers like soap flakes. This suggests that an enzyme is employed to soften the mucus. Campion (1961) demonstrated the presence of a proteolytic enzyme in a snail mucus which could be used for this purpose. Occasionally, a naturally-shed epiphragm is more fluorescent than an artificially removed specimen, which could be due to the presence of an enzyme, since enzymes are moderately fluorescent. This may be purely fortuitous, however, as the fluorescence of epiphragms varies.

Acknowledgments

My sincere thanks are due to Dr V. Fretter, Dr M. P. Kerney, Professor J. Morton, Dr B. Verdcourt, and many other members of the Conchological Society for reading drafts of this paper, for useful suggestions, book loans, and general help and encouragement, to Mr D. Heppell for his work in drawing several additional references to my attention, to Mr B. Pounsett for his skill and ingenuity in devising apparatus for my experiments, and to Douai School for the use of laboratory facilities.

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J. Conch. **26**: 410–416 (1971)

UNDESCRIBED POLYMORPHISMS IN TWO BRITISH SNAILS

A. J. CAIN
Department of Zoology, University of Manchester*

(*Read before the Society*, 18 *November* 1967)

Polymorphisms are of special interest to students of variation but are seldom distinguished from other types of variation in the literature on Mollusca. This paper describes two noticed during investigation of snail populations at Oxford, one remarkable in that it involves only the pigmentation of the mantle, the other in that it recalls the far more vivid colour polymorphism in *Cepaea*, at first sight apparently unique in British snails.

1. POLYMORPHISM OF MANTLE PIGMENTATION IN *Monacha cantiana*

A large random sample of *Monacha cantiana* (Montagu) was taken from the former genetics garden (now destroyed) in the Department of Zoology, Oxford, into which it had apparently been accidentally introduced. Examination suggested a polymorphism of two classes, light and dark mantle; accordingly, the bodies were extracted from the shells (which were scored for the amount of reddish-brown pigment near the mouth) and examined separately. Light individuals have on the mantle an irregular black mark like a collar, sometimes reduced to two black blotches, or to a single one, immediately behind the mantle-edge which secretes the periostracum and more or less covers the distal end of the rectum. From the collar or blotches backwards, the mantle is white as far as the area covering the hepatopancreas, which is dark. In dark individuals, the area of the mantle which is white in the light ones is more or less heavily mottled with dark reddish-, often almost blackish-, brown. The kidney region is paler. In many, this mottling is so strong as to be a nearly uniform darkness; in less pigmented individuals, the black collar already described for the light form is clearly visible; in still less pigmented ones, a considerable median area of the mantle is very pale or wholly white, so that the mottling is restricted to the areas near the kidney, and especially to those near the collar.

There is therefore considerable variation in pigmentation among the dark forms (there could hardly be in the light ones, which have so little pigment). Since the mottling is too coarse, as a rule, to match against a colour atlas, the specimens were ranked in sixteen classes from darkest (1) to the lightest possible, with no mantle pigment (16), which was not exemplified in this sample. The

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results are given in the top line of Table 1, and the corresponding histogram is shown in Fig. 1. There is a strong bimodality, with a broad peak from about 4 to 10, and a very sharp one at 14. The scoring was done by ranking only, however, and there is no unoccupied rank between the peaks; moreover, there is much variation within the dark class. It might be argued that a large number of genes affecting degree of pigmentation were involved, not a polymorphism, and that these produced a continuous variation up to the point of no mottling at all on the mantle, when (clearly) further inhibition of pigment could have no effect; this would produce a class of light-bodied individuals apparently very homogeneous, but genetically as heterogeneous as the rest of the sample. Or it might be thought that the ranking was very uneven, and the appearance of two peaks was due merely to a finer division of the group between them, so that frequencies in each rank were reduced. In fact, a careful effort was made to rank as uniformly as possible, but ranking is never wholly satisfactory.

Accordingly, two pairs of half-grown *M. cantiana*, a dark and a light in each, were put into breeding pots. Heavy infant mortality left only 37 juveniles for scoring, but even at a very early age there was a clear separation into 29 with strong mottling and blotching of the mantle, and 8 with only the well-marked black blotch representing that part of the black collar nearest the suture of the shell and a very few scattered tiny spots on the rest of the mantle-region in question. As expected, there was some variation in the dark class, but not at all sufficient within these broods to obscure the polymorphism. A cross of two light-bodied individuals gave only six young, all light-bodied. There seems no doubt, therefore, that there is a genetic polymorphism of light and dark mantle in *M. cantiana* with dark dominant.

One feature of the variation in this species that may have helped to conceal this polymorphism from notice is that there is little or no correlation between the pigmentation of the exposable parts of the body, especially the foot-sole, and that of the mantle. When the live Oxford sample was originally sorted by eye into lights and darks, confirmed by later extraction of the bodies, the whole range of variation in pigmentation of the head and foot (and this is considerable) was seen in both classes. This contrasts with the situation in *Hygromia striolata* (C. Pfeiffer), where the pigmentation of head, foot and mantle varies as a single entity.

In *Hygromia striolata*, both body and shell are polymorphic and there is a strong linkage between their characters (Cain, 1959a, b). In *M. cantiana* the colour of the shell varies somewhat in respect of the amount of reddish-brown pigment near the mouth. A few are nearly white. Most have some tinge of red-brown. This is most intense below the periphery, along which there is a more or less distinct white zone. In some shells there seems to be no red-brown above the periphery; in others only a faint trace near the mouth; in yet others it is as intense as below the periphery, so that the peripheral zone stands out

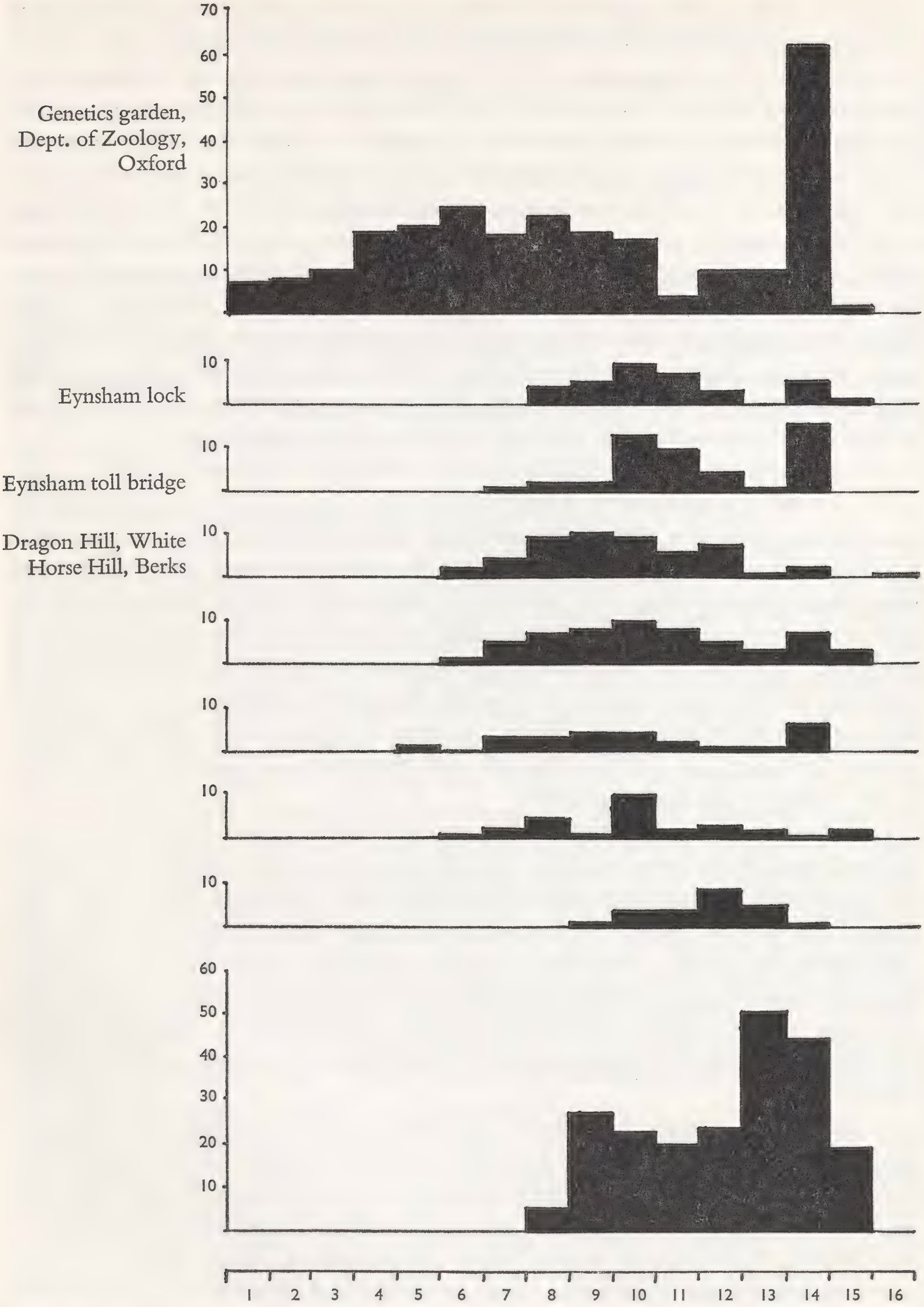

Fig. 1. Frequency histograms for darkness of mantle in random samples of *Monacha cantiana*, ranked from 1 (darkest) to 16 (no dark pigment).

Mollusk

The Journal of Conchology, Vol. 26, No. 6

As a result of a composing oversight figure 1 on page 412 was printed incomplete — a corrected version of this page is enclosed herewith.

Latimer Trend & Co. Ltd., Plymouth

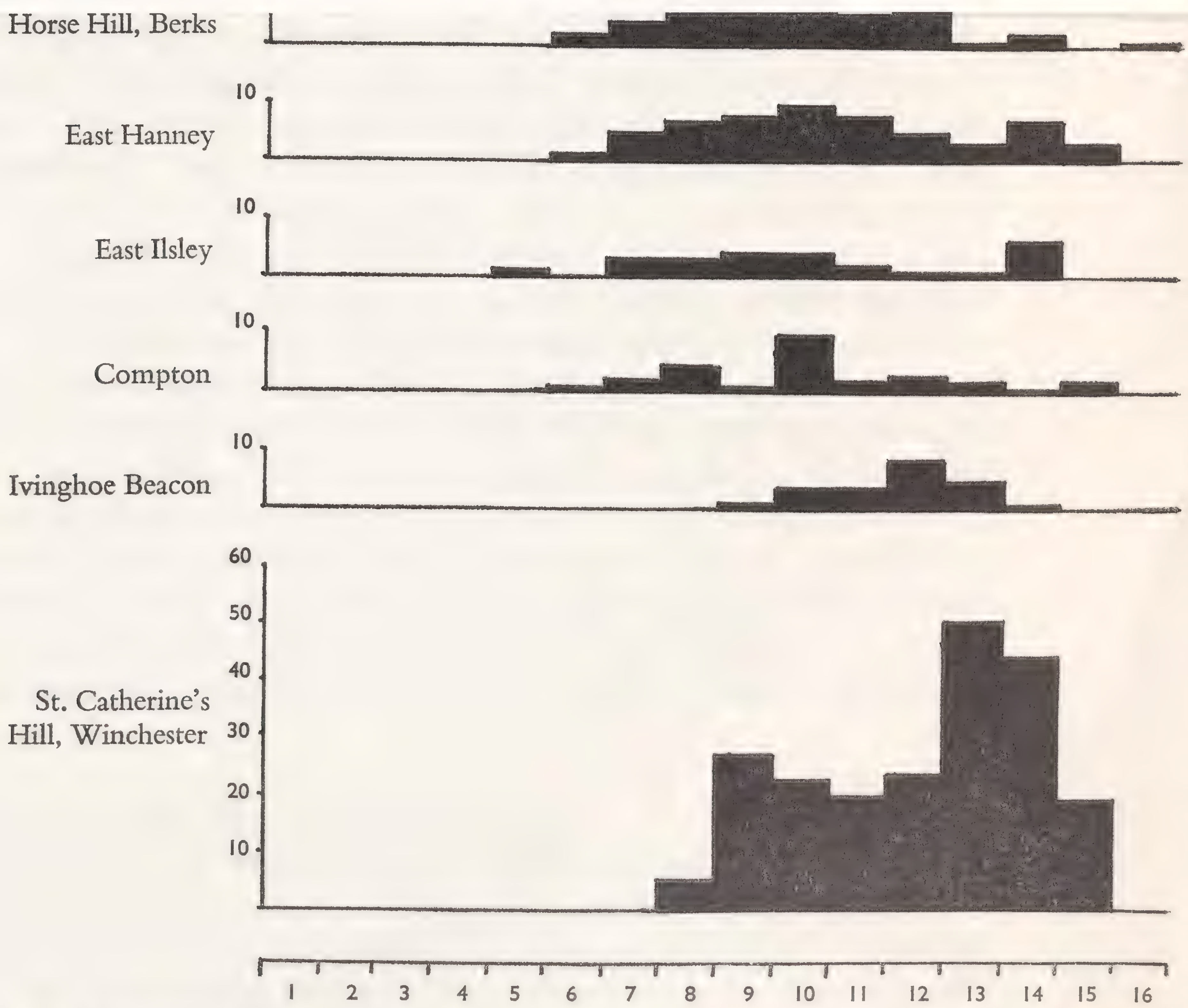

Fig. 1. Frequency histograms for darkness of mantle in random samples of *Monacha cantiana*, ranked from 1 (darkest) to 16 (no dark pigment).

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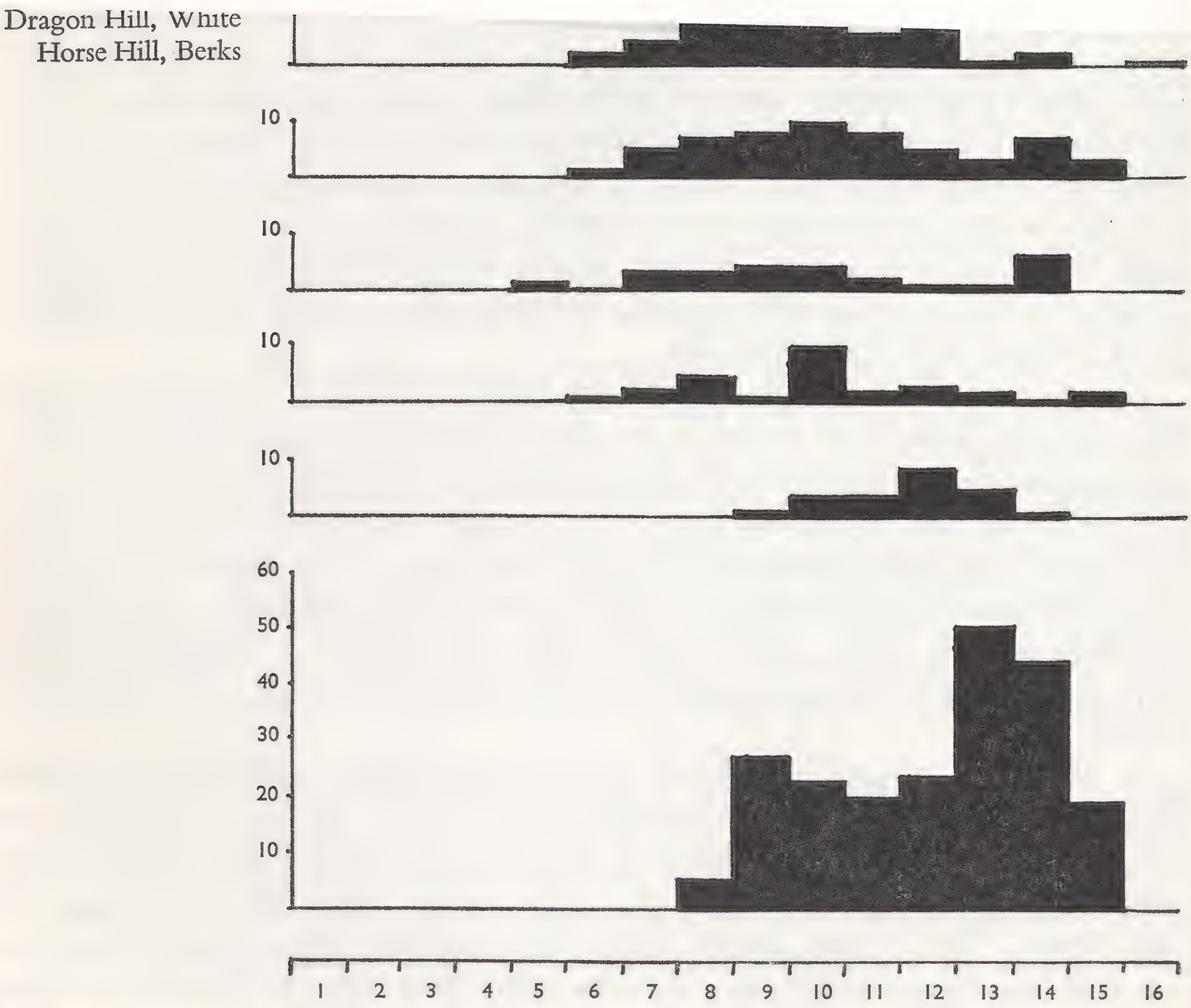

Fig. 1. Frequency histograms for darkness of mantle in random samples of *Monacha cantiana*, ranked from 1 (darkest) to 16 (no dark pigment).

Mollusk

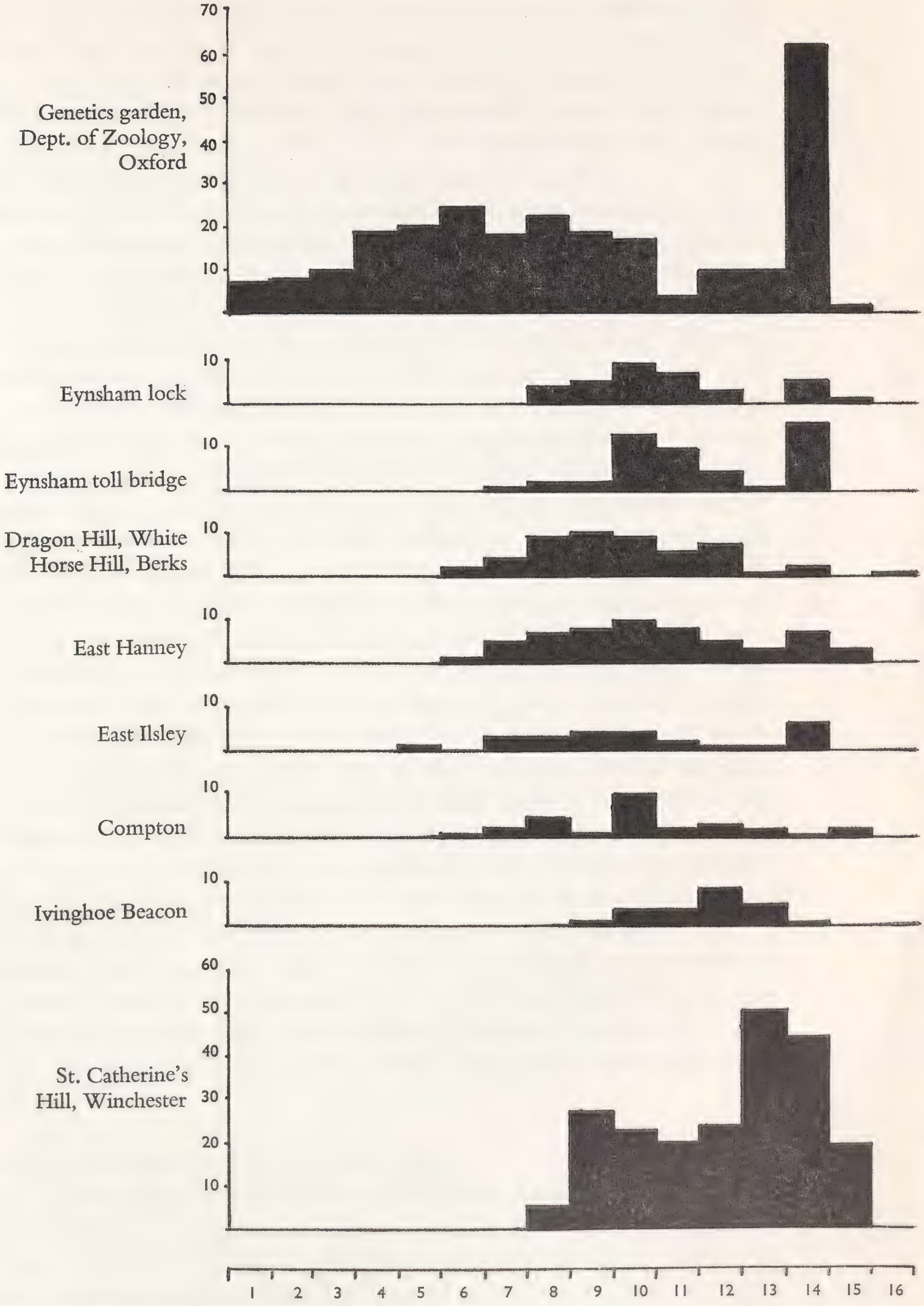

Fig. 1. Frequency histograms for darkness of mantle in random samples of *Monacha cantiana*, ranked from 1 (darkest) to 16 (no dark pigment).

SMITHSONIAN
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clearly. But the red-brown above is always more restricted to the vicinity of the mouth than that below the periphery. This variation appears to be continuous. For scoring, it was divided into six classes from 1, most pigment, to 6, white. Table 2 shows the shell scores for the dark and light mantle classes of the Oxford sample separately; variation in the two classes is so similar that there can be little association, if any, between shell colour and mantle pigment.

Several samples of *M. cantiana* from less artificial situations have been scored for mantle pigmentation and shell colour; Tables 1 and 3 and Fig. 1 give the results. In several samples there is a good indication of the same mantle polymorphism as in the Department sample, and it has been seen in a large sample examined *in situ* in rough herbage by a roadside at Cornwell, near Chipping Norton. The large collection from open downland grass on St Catherine's Hill, Winchester, is especially interesting, since the darks are shifted in respect to mantle pigment towards the paler classes; the sharp peak is at 13 and 14, instead of 14 only, and in fact the histogram by itself gives little evidence of a polymorphism at all. Much smaller samples, also from chalk districts (Ivinghoe Beacon, Compton, Dragon Hill), give little indication of a sharp peak, but others from the Oxford district (Eynsham lock and toll bridge) and on the chalk (East Ilsley) show it. The Ivinghoe sample shows the same shift towards paleness as the Winchester one; none has as dark a range of the dark class as the Department sample (although a very small one from the crossroads by Stow Wood near Oxford consists of one individual each in ranks 2, 5, 6, 7, 8, and 9, which is similar). It is clear that there are considerable variations from place to place, both in proportions of darks and lights and in the variation within the dark class—this last to such an extent that the polymorphism might be obscured. The samples available are not sufficient to allow any certain conclusion on variation with habitat, but it may perhaps be noted that the two samples from open downland grass (Winchester, Ivinghoe) have especially pale darks; all the other samples are from rather deep herbage, or in association with bushes.

Table 3 gives the shell scores for the samples shown in Table 1. As with the Department sample, there is no indication of any polymorphism; the principal frequencies vary considerably, even between nearby localities (Eynsham lock and toll bridge), and there is no sign of variation with habitat, but further investigation is needed.

2. POLYMORPHISM OF SHELL COLOUR IN *Helix aspersa*

In progeny of *Helix aspersa* Müller from two localities, Oxford, and Compton (Berks.), a segregation has been noticed for pale yellowish-brown against reddish-brown periostracum. The difference is easily seen in individuals about one quarter grown, on the underside of the shell and often all over it. It is often but not always visible in adults; the last whorl of the shell may not show it at all. The mottlings that give this species its specific name tend to obscure it. The reddish form seems to have an infusion of a red pigment; the yellowish ones may merely lack this or have some yellow pigment. A bright pink and bright yellow polymorphism is of course well known in *Cepaea*; if this in *H. aspersa* is the same it is heavily obscured by a brown pigment, as in *Arianta arbustorum* (L.). Taylor (1911) figures specimens the spires of which correspond fairly well in colour with these classes. His two typical specimens and that of the sub-variety *undulata* have yellow-brown spires, while that of *punctulata* has a red-brown one. Scoring is easier in juveniles than these pictures would lead one to believe.

The results of mating together red-browns from Oxford are as follows:

MATING	RED-BROWNS	YELLOW-BROWNS	TOTAL
A1	137	53	190
A2	165	29	194

These show that yellow-brown is recessive to red-brown. Matings from the progeny of A1 produced only a few offspring:

	MATING	RED-BROWNS	YELLOW-BROWNS	TOTAL
A 13	red-brown × red-brown	3	8	11
A 14	red-brown × yellow-brown	12	0	12

which is consistent with yellow-brown being recessive. Further, juveniles from Compton were sorted into two pots by colour and allowed to grow up and mate in them. The breeding pot containing only red-browns produced 10 red-brown and 6 yellow-brown offspring, while that with yellow-browns only produced 19 offspring, all yellow-brown as would be expected, if it is recessive.

ACKNOWLEDGMENTS

I am indebted to Dr B. C. Clarke and K. A. Reynolds for samples, and to J. M. B. King for assistance in the breeding. This work was part of a programme in molluscan genetics supported by the Nuffield Foundation.

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Table 1

Mantle pigmentation in Random Samples of *Monacha cantiana*

PIGMENT SCORE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
LOCALITY																	
Oxford, Dept of Zoology	7	8	10	19	21	25	18	23	19	17	4	10	10	63	2		256
Eynsham lock								4	5	9	7	3		5	1		34
Eynsham tollbridge							1	2	2	13	10	4	1	16			49
Dragon Hill						2	4	9	10	9	6	8	1	2		1	52
E. Hanney						1	5	7	8	10	8	5	3	7	3		57
E. Ilsley					1		3	3	4	4	2	1	1	6			25
Compton						1	2	5	1	10	2	3	2	1	2		29
Ivinghoe Beacon									1	4	4	9	5	1			24
Winchester								5	27	23	20	24	51	44	19		213
	7	8	10	19	22	29	33	58	77	99	63	67	74	145	27	1	739

Table 2

Shell coloration and Mantle pigmentation
in the Oxford Sample of *Monacha cantiana*

SHELL COLOUR	Reddish 1	Deep 2	Medium 3	Light 4	Pale 5	White 6	TOTAL
Dark bodies	17	41	31	50	29	8	176
Light bodies	3	18	18	32	18	5	94
	20	59	49	82	47	13	270

Table 3

Shell coloration in Random Samples of *Monacha cantiana*

Pigment Score	1	2	3	4	5	6	Total*
Locality							
Oxford, Dept of Zoology	20	59	49	82	47	13	270
Eynsham lock		2	5	10	13	3	33
Eynsham tollbridge	6	18	10	10	4		48
Dragon Hill	1	2	3	9	13	4	32
E. Hanney	2	19	13	19	4		57
E. Ilsley	1	9	6	5	3		24
Compton	2	8	7	8	4		29
Ivinghoe Beacon		2		4	7	12	25
Winchester	14	53	81	46	17		211
	46	172	174	193	112	32	729

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* The figures in the Total column differ from those in Table 1 because fresh dead shells could be used for shell scores, and very large juveniles could be used for mantle but not shell scores.

J. Conch. **26**: 417 (1971)

PHYSA IN EAST AFRICA

B. Verdcourt
Spring Cottage, Kimbers Lane, Maidenhead, Berks.

(*Read before the Society*, 21 October 1967)

Recently van Bruggen (1966: 50) has recorded *Physa acuta* Draparnaud from Kampala in Uganda. It is worth mentioning other records of this species from East Africa since, around Nairobi, Kenya, at any rate, it is not uncommon and has in fact proved a nuisance by becoming a contaminant in cultures of *Biomphalaria* and *Bulinus* being maintained for research on the transmission of bilharzia.

Connolly (1925: 189) mentioned that he had specimens of a *Physa* from Lake Naivasha, Kenya, which he considered represented a new species and also noted that Thiele had confirmed the generic placing of *P. mosambiquensis* Clessin. Pilsbry & Bequaert (1927: 147) stated that the animal of *P. waterloti* Germain (described from Porto Novo, Dahomey) was unknown, that *P. opaca* Lamarck was common in Lower Egypt, and also mentioned Connolly's supposed new species. Later, Connolly (1929: 170) referred the Lake Naivasha specimens to *P. subopaca* Lamarck and commented that *P. mosambiquensis* and *P. waterloti* were the only other species known from tropical Africa.

When specimens of a *Physa* started turning up in Nairobi, I sent some to Dr G. Mandahl-Barth who identified it as *P. borbonica* Férussac, and I (Verdcourt, 1956) reported it under that name. Mandahl-Barth (1962: 145, fig. 5) mentioned the genus in a key to African freshwater snails, and figured *P. borbonica*, but the origin of the material was not stated. In answer to a recent letter, Dr Mandahl-Barth tells me that he now considers that *P. borbonica* and *P. subopaca* are certainly synonyms of *P. acuta* and that he has samples from Ethiopia, Kenya, Rhodesia, Transvaal, Natal, Mauritius and Madagascar.

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J. Conch. **26**: 418–421 (1971)

OBITUARIES

HERBERT LEADER HAWKINS, F.R.S., 1887–1968

Professor H. L. HAWKINS, F.R.S., the eminent geologist and Emeritus Professor of Geology in the University of Reading, died on Sunday, 29 December 1968. He was 81. HAWKINS had an international reputation for his erudite works on fossil sea-urchins. As founder of the Geology Department at Reading, and its guide for 43 years until his retirement in 1952, he will always be remembered as a wise counsellor by those fortunate enough to come under his spell.

HERBERT LEADER HAWKINS was born in Reading in 1887 of Quaker parents. He was educated at Reading School. The Reading Beds provided his first introduction to geology whilst still a schoolboy. From Reading, HAWKINS went on to Kendal and thence to Owens College, Manchester, with a classical scholarship. At Manchester he became the first Mark Stirrup Scholar in Palaeontology and graduated with first class Honours in 1908, gaining his M.SC. in 1909 and D.SC. in 1920.

In 1909, whilst still a Research Scholar at Manchester, the request of two students to take the London Intermediate Examination in Geology provided an opportunity for HAWKINS to begin lecturing part-time at University College, Reading. He was soon offered a permanent place on the staff. Starting with a precarious foothold in the Zoology Department, through the generosity of Professor F. J. COLE, he worked quietly away to develop a Geology Department at Reading. HAWKINS was appointed Professor of Geology in 1922.

His steady stream of publications commenced in 1909 and continued until 1956. The country around Reading provided his keen eyes and skilful hands with a rich harvest indeed. His earliest papers contain the results of his studies of structures in some fossil Echinoidea. These studies on specimens extracted from the local rocks were supplemented by work on material from other parts of the world. HAWKINS's thoughts on this class of the animal phylum Echinodermata were brought to a culmination in his Address to the Geological Society of London in 1943 on *Evolution and Habit among the Echinoidea: some Facts and Theories.*

HAWKINS had the gift of being able to paint the broader geological picture. As a palaeontologist, he was well qualified to comment on the human race, and such articles of his as *A Palaeontologist looks at Life*, *Palaeontology and Humanity*, *Humanity in Geological Perspective* and *Fossils and Men* can be read with pleasure and profit. This is also true of his other Address to the Geological Society, *Some Episodes in the Geological History of the South of England* (1942). It is tempting to suggest that this latter review stemmed from his long interest in the beautiful

Vale of Kingsclere, just beyond his native Berkshire. His detailed work on part of BUCKLAND's 'type-specimen' of a 'Valley of Elevation' demonstrated the value of the hand-auger for elucidating structures in suitably soft rocks.

It is clear that HAWKINS recognized no separation of pure and applied science so far as his geological work was concerned. His knowledge of the succession and structure of the local rocks led naturally to his being involved as geological adviser to the Thames Valley and Metropolitan Water Boards. The investigation of the proposed Enborne Valley reservoir site led to the discovery of a pinnacle of Chalk penetrating the Eocene strata on the floor of a buried river-channel. HAWKINS also carried out an investigation of the phosphatic Chalk of Taplow.

HAWKINS was elected a Fellow of the Royal Society in 1937 and served as President of several societies. He was President of the Cotteswold Field Club from 1929 to 1931, the South-Eastern Union of Scientific Societies in 1934 and again in 1958, the Geological Section of the British Association at its Blackpool meeting in 1936, the Geologists' Association in 1938, the Geological Society of London in 1941–42 and President of the Palaeontographical Society from 1943 to 1965.

As a scientist, HAWKINS combined observation of detail with a vivid imagination. Believing strongly that a geologist is a historian of the earth, he clearly saw his duty to tell a story. Those who were fortunate enough to hear him lecture and those who read his papers will always be grateful.

HAWKINS had a daughter and two sons by an earlier marriage. In 1955, he married SYBIL M. HAMPTON with whom he had collaborated in some of his work. She survives him.

N. E. BUTCHER

DOUGLAS KEELY KEVAN, 1895–1968

DOUGLAS KEELY KEVAN who died suddenly in Edinburgh on 15 May 1968 was for many years actively interested in British Mollusca. He was born at Chelmsford, Essex, on 4 February 1895, son of ALFRED KEELY KEVAN and LAURA KATE RADCLIFF. His father died when DOUGLAS was only ten, he left school at the age of fourteen and thereafter was entirely self-educated. He joined the firm of G. F. Neame & Co. [now Price and Pierce], timber merchants, in 1911 and was with them until he retired in 1958. During the First World War he was with the Territorial London Scottish and was mobilized from camp in 1914, just missing being an Old Contemptible by one day. He served in the London Scottish second draft, was invalided out in January 1915, transferred to the Army Service Corps becoming 2nd Lieutenant in May 1915, and was discharged in 1919 with the rank of Acting Captain. He rejoined his firm and was their agent in Finland until 1921 when he was made agent for Scotland, North England and Ireland. He came to live in Edinburgh in 1922. In December 1921 he took first place in the examinations of the London Association for Accountants and was made a member of the Corporation of Accountants in 1922. He became a member of the Merchant Company of Edinburgh in 1937, a Fellow of the Royal Society of Edinburgh in 1943, and a Fellow of the Royal Entomological Society of London in 1950 and he was for many years Treasurer of the Royal Physical Society of Edinburgh. He was elected a member of the Conchological Society on 3 May 1930.

Although he was fully employed as timber agent and corporate accountant he had a life-long interest in Natural History. His first interest was in marine molluscs but he had already turned to the land and freshwater species when the writer met him in 1930. In those early days his interests were still wide and on collecting excursions his enthusiasm outstripped his technique and he was liable to put slugs, snails, beetles and anything that took his fancy into the same container. He soon developed and improved his techniques, specializing in the smaller species of land and freshwater shells of which he became a leading authority in Scotland. He will be remembered for the considerable contribution he made to our understanding of the habits and distribution of both *Vertigo* and *Pisidium*. In later years his interest was in the Coleoptera and he revised several of the more difficult British genera, dissecting both males and females and figuring many new characters. This work led to the addition of a number of species to the British fauna. His fine collection of British Mollusca and Coleoptera have now been presented to the Royal Scottish Museum.

He was widely read and entered deeply into any subject which appealed to him. He was also an accomplished pianist and a prolific composer of fugues. A charming companion in the field he had an indefatigable zest for collecting the minute and a robust sense of humour.

He married GWYNNYTH PAINE of Wood Green, London, in 1919 and is survived by her and a son, Professor D. K. McE. KEVAN, to whom our warmest sympathy is extended.

CONCHOLOGICAL PUBLICATIONS OF D. K. KEVAN

1930 New Scottish county records of land and freshwater Mollusca. *Scott. Nat.* **for 1930**: 27–29.
1930 Land and freshwater Mollusca of Great Cumbrae. *Scott. Nat.* **for 1930**: 117–119.
1931 Report on the molluscan fauna of Duddingston Sanctuary (with Supplement). *Scott. Nat.* **for 1931**: 15–22, 55–58.
1931 The occurrence of a rare snail (*Succinea oblonga*) in East Lothian and Stirlingshire. *Scott. Nat.* **for 1931**: 185–186.
1933 [With A. R. WATERSTON] *Vertigo lilljeborgi* (West.) in Great Britain (with additional Irish localities). *J. Conch.* **19**: 296–313.
1933 *Vertigo angustior* (Jeffr.) and *Acicula lineata* (Drap.) in Co. Kildare. *Ir. Nat. J.* **4**: 178–179.

1933 The alleged occurrence of *Vertigo moulinsiana* (Dupuy) in Cumberland. *J. Conch.* **19**: 329–330.
1933 Notes on the malformation of the shells of bivalve Mollusca. *Scott. Nat.* **for 1933**: 11–16.
1934 *Spisula* (*Mactra*) *subtruncata* (da Costa) in the Firth of Forth. *Scott. Nat.* **for 1934**: 27.
1934 *Limapontia depressa* (A. & H.) *var. nov.* in Scotland. *J. Conch.* **20**: 16–24.
1934 *Limnaea pereger* Müll. var. *maritima* Jeff. at Gullane Point, Firth of Forth. *J. Conch.* **20**: 59–60.
1934 *Vallonia costata* (Müll.) *monstr.* from East Lothian. *J. Conch.* **20**: 82–83.
1937 A rare slug *Limax cinereoniger* Wolf, in Midlothian. *Scott. Nat.* **for 1937**: 102.
1939 Further notes on *Limapontia depressa* (A. & H.) var. *pellucida* Kevan. *J. Conch.* **21**: 160–162.
1960 Further Scottish records of *Potamopyrgus jenkinsi* (Smith). *J. Conch.* **24**: 399–401.

A. RODGER WATERSTON

DOUGLAS PANTON BLAIR, 1883–1968

DOUGLAS PANTON BLAIR, a member of the Conchological Society from 1925 for about twenty years, was born in Perth, Scotland, and was educated at Perth Academy, followed by obtaining M.B. and CH.B. at Edinburgh University in 1905. He was in general practice first in Bedford and then in Sunderland. In 1915 he joined the Army as a tropical diseases specialist and was stationed for some time at Bushire on the Persian Gulf, later at various places in Egypt and Palestine and at all these places he collected Mollusca enthusiastically. After the war he practised in Waterloo, near Liverpool, where he and his nephew Dr D. BLAIR MACAULAY built up a large general collection which eventually came to Liverpool Museums in 1958.

Dr BLAIR was also much interested in anthropology and in 1966 he took his M.D. at Edinburgh (he was then 83!) with a thesis on medical anthropology. He died at Blundellsands near Liverpool in January 1968.

NORA F. MCMILLAN

REVIEWS

British Shells by NORA F. MCMILLAN, illustrated by G. D. HYSLOP and BRIDGET FINLOW. London: Warne, 1968. pp. xii + 196, with 32 colour pls. and 48 plain pls. 8½″ × 6″. *Wayside and Woodland Series*. Price £2·50.

Mrs MCMILLAN's original task was to revise *Shell Life* by EDWARD STEP. Finding this impossible, she has written what she calls an entirely new book to take its place. The result, *British Shells*, is a book which will aid the beginner, rather than the more advanced student of conchology, to identify specimens by their shell characters. But in several aspects the book suffers from limitations which one suspects are caused by it being part of the Wayside and Woodland Series.

Following introductory sections on the habits of molluscs and how to collect them, and a short chapter on the economic uses of edible species, Mrs MCMILLAN explains the whys and wherefores of classification and naming. After this is a glossary and a useful explanation of how to tell the left valve from the right in bivalves.

The body of the book consists of brief notes on every British mollusc, starting with the marine species. In this section species are generally listed in the order given in WINCKWORTH, 1932 (*J. Conch.* **16**: 211–252), together with his nomenclature. There are some additions. The descriptions of the marine Gastropoda is the most valuable part of the book. It fills in for the beginner the numerous gaps left by STEP (op. cit.) and BARRETT & YONGE (*Collins Pocket Guide to the Sea Shore*), but more experienced collectors will not be entirely satisfied. The approach to marine bivalves is rather less detailed and technical than that of TEBBLE (*British Bivalve Seashells*), but scores heavily with the notes comparing and contrasting species which are very alike. On this last point it is also easier to follow than JANUS (*Molluscs*) where freshwater and land species are concerned. There is a useful bibliography, and the last chapter of the book is a classified list of species. This, however, appears to be a left-over from STEP (op. cit.). It is unlikely to be consulted by the beginner, and the advanced student, who would find it very convenient to use in the updating of specific names in conjunction with reference to older literature, has already outgrown the rest of the book.

The chief values of *British Shells* are twofold. Firstly, there are notes on all the British molluscs within the covers of one book. Secondly, the illustrations are magnificent. The standard of these, with few exceptions, is so high that one wishes that every species were represented. One could also wish for more detail of the inner side of bivalve shells.

As a book for beginners, the descriptions are generally clear but not always helpful. For instance where bivalves are concerned there is insufficient reference to the inside of the shell. Also it assumes much to expect users of this book to be familiar with all those commoner species which, although appearing in their proper place, are not described: for instance (p. 88), '*C. edule* L. (Plate 54: 3) Common Cockle. Needs no description.' Also obvious features such as spines on the Spiny Cockle are taken for granted. Whilst on the subject of cockles, I doubt Mrs MCMILLAN's statement that *C. crassam* (Gmelin) is ribless (p. 88), especially in view of the illustration (Plate 37: 1) which shows the ribs. There are the usual shortcomings about maximum range and size of species which, however, only serve to please the reader when he finds something further afield or bigger! What one misses very much is a series of keys to help with initial identification, such as that found in TEBBLE (op. cit.). The somewhat haphazard arrangement of the illustrations, which one has to use instead, is confusing.

The book is a basis for learning much about shells before progressing to the classic FORBES & HANLEY (*History of British Mollusca*) and JEFFREYS (*British Conchology*), but the serious student will quickly outgrow it and wish for more detail. At £2·50 it is an expensive buy for the short term. The much cheaper works by TEBBLE and JANUS have much more to offer in their spheres. Many people might consider buying *British Shells* for the section on marine Gastropoda alone, but one feels that a book dealing with this subject on its own in greater detail would make a more useful contribution to the literature.

Shelagh M. Smith

Rare Shells by S. Peter Dance. London: Faber & Faber, 1969. pp. 128, with 50 colour pls. 10″ × 7½″. Price £6.

In this book the author has broken new ground, for although there is much scattered literature on rare shells, there is no connected account of the subject such as the work now before us and certainly nothing approaching it in quality.

Part I is a 20-page essay on the growth of the rarity 'fever' of the grand days of shell collecting (approximately the later seventeenth and the eighteenth centuries) and on how this was stimulated by the acquisitions of some of the great voyagers, such as James Cook and Hugh Cuming. It includes also a brief, but brilliant, account of some of the early auctions at which the treasures have changed hands. Part II consists of 50 colour plates of rare shells, each with printed matter on the depository, price and conchological history of the illustrated specimen and in most cases with documentary references of very wide ambit. Indeed, the documentation throughout the book is in itself an achievement.

Although there are many rare land and freshwater molluscs, Mr Dance has limited his work to marine shells, and 'showy' ones at that—cones, volutes, murices, cowries and so on—and this is easy to understand. For in the competition between rarity *sensu stricto* and rarity combined with beauty the marine shells have always won. The illustrations are approximately of natural size and the colour work is excellent, with the one reservation that in some plates the blue is overdone: for example, a *Cypraea aurantium* (Plate 5) with a blue margin as shown would surely be a super-rarity. Nevertheless, these plates are a delight to the eye, apart from the feast of information in the commentaries that accompany them.

Rarity, as the author reminds us, is governed by two factors, scarcity in nature and scarcity in the market. So it has come about that some shells that were once extremely rare have now lost their rarity, for example as instanced by Mr Dance in the case of the beautiful Junonian volute. He gives other examples and could have given more among his fifty selected species. Such as case is *Astraea heliotropium* Martyn, quoted in *Van Nostrand's Standard Catalog of Shells* (2nd edn.) at $3·00 for a perfect specimen with detailed locality data. The same catalogue cheerfully quotes $50 for *Conus dusaveli* H. Adams, very different from the original £80 mentioned by the author with his comment that no other specimen had yet been found. Perhaps the most spectacular fall has been that of *Epitonium scalare* (L.), cited by Mr Dance as tumbling from Kaiser Franz I Stephan's purchase at 4,000 guilders in about 1750 to the New York auction price of $16 in 1967. But even this can be beaten: whereas I. H. Chemnitz in his *Testaceo-theologie*, 1760 [letter to the poetess Jungser Margaretha Bürckmännin, p. 103], cites a 'Capitaale Wenteltrap' at 502 florins in a Dutch catalogue, W. F. Webb and G. A. Melvin in 1967 rated it respectively at $5 and $3·50 and upwards, depending on size.

Rare shells are a fascinating subject and Mr Dance has conveyed that fascination very ably. As a companion to his earlier book *Shell Collecting* he has now given us a luxury volume, luxuriously produced, and anyone interested in the rarity, historicity or beauty of shells will be amply rewarded by possessing a copy.

Arthur Blok

Shells and Shellfish by J. C. SMYTH, illustrated by DAVID PRATT. Edinburgh: Oliver & Boyd, 1968. pp. 60, with 7 colour pls. and numerous text-figs. 8½″ × 7″. *Open Air Library* No. 3. Price 77½p.

'It is an odd thought that a precious pearl in a lady's brooch is really the tomb of a little worm that got lost.' Even if parasitic irritation is not the cause of every pearl, this reflection on p. 54 of Dr SMYTH's book demonstrates his thought-provoking approach to the study of shells and their inhabitants. Concern with the implications of facts is a natural way to encourage the young readers for whom this book is evidently intended to think for themselves. It is a pity that treated thus far in a fully adult fashion, beginners having their first taste of conchology are not introduced to the scientific names of shells beyond their main classes. Common names are used all through the book without their scientific equivalents, although one feels that even if they were not used in the text they could have been correlated with the proper names in the index. In at least three instances the 'common' names are in fact rather uncommon, e.g. *Patina pellucida* is usually referred to as the 'blue-rayed limpet' rather than the 'kingfisher limpet', whilst *Cepaea nemoralis* and *C. hortensis* are more often described as the 'brown-lipped' and 'white-lipped' snails than the 'grove' and 'garden' snails.

Shells and Shellfish is primarily about the living animals, dealing with the way they breathe, feed, create their shells and maintain themselves in their environmental niches. Parasites and other enemies of molluscs are described and figured as a very real part of the ecological pattern. This emphasis on the one-ness of the study of shells and their makers in an introductory work on shells is surely deserving of a more alluring title or at least an expanded sub-title.

Mr PRATT's coloured illustrations are passably good, but mostly lack the ripples, glistenings and translucences which one associates with *living* molluscs, although an exception can be made for the black slug shown in the plate facing page 28. This kind of illustration is a defect in a book which places the emphasis on the living animal. The black-and-white figures are mostly too coarsely shaded and hard of outline. Some, like those of the zebra mussels are complete failures in so far as they are intended to delineate shells of living animals. However, any viewed through a diminishing glass will be seen to be greatly improved and one suspects the publisher of reproducing them at equal or increased size to the originals: nevertheless the scraper-board drawing of the glochidium larva has both accuracy and charm. It should be mentioned that all the figures have relevance to the writing and present a wide diversity of molluscs and their ways of life: they are also delightfully arranged in the text.

The style with rather short sentences is probably suited to the youthfulness of its readers. However, on p. 39, simplicity leads to an inverted presentation of causality in the sentence 'on the shore waves and tides stir some of this decaying matter into the water so that bivalves can take it in'. On p. 49 the author lapses from his customary care in using the qualifying term 'usually' when he states that the opercula of all shells are horny.

Dr SMYTH is to be congratulated on the way he has written a book for young people without sacrificing scientific accuracy. Some adults intent only on acquiring perfect shell specimens would find their interest widened not a little by reading this account which even, very justifiably, recommends a collection of damaged shells to demonstrate the molluscs' encounters with what are described as 'looters and lodgers' of various kinds. One's impression is that the merits of the book belong to the author and artist whilst the demerits—popular title, lack of scientific names and blown-up drawings—may be better placed at the door of the publishers—including the somewhat inflated price.

STELLA M. TURK

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

MEMBERS ELECTED

847th Meeting, 20 April 1968

Miss ELIZABETH MARGARET ALLISON, Grove Cottage, Yarmouth, Isle of Wight.
IAN GRANT CUMMING, Department of Natural History, The Royal Scottish Museum, Chambers Street, Edinburgh 1.
G. R. EATON, 56 Beauchamp Avenue, Bridgemary, Gosport, Hants.
Miss JEAN ROSEMARY FINNEY, 267 Liverpool Road, Widnes, Lancs.
LINNEAN SOCIETY OF LONDON (Library), Burlington House, Piccadilly, London W1V 0LQ.
COLM, E. O'RIORDAN, M.SC., PH.D., Natural History Division, National Museum of Ireland, Kildare Street, Dublin 2, Irish Republic.
Dr DWIGHT W. TAYLOR, Department of Zoology, Arizona State University, Tempe, Arizona 85281, U.S.A.

848th Meeting, 18 May 1968

R. B. ANDREWS, 16808 Bolero Lane, Huntington Beach, California 92647, U.S.A.
PH. BOUCHET, Le Bocéno, 56 Auray, France.
Mrs A. CAMERON, 62 Salutation Road, Darlington, Co. Durham.
The Right Hon. the Viscount CHAPLIN, F.L.S., Westray House, Blackawton, Totnes, Devon.
BRIAN, A. COULTAS, B.SC., L.I.BIOL., 151 Beechwood Drive, Feniscowles, Blackburn, Lancs.
GILBERT DINESEN, 'Procul Negotiis', Great Woodcote Park, Purley, Surrey.
Mrs JANET MCAUSLAN HEPPELL, Institute of Physiology, The University, Glasgow W.2.
KEITH, G. MANTLE, 99 Stream Road, Kingswinford, Brierley Hill, Staffs.
NEW ZEALAND GEOLOGICAL SURVEY (Library), P.O. Box 30368, Lower Hutt, New Zealand.
RICHARD E. PETIT, P.O. Box 133, Ocean Drive Beach, South Carolina 29582, U.S.A.
Miss MADELINE BERWYN POWELL, 'Lavengro', Borrow Road, Oulton Broad, Lowestoft, Suffolk.
MICHAEL ROWE, 20 Grange Road, Lillington, Leamington Spa, Warwickshire.
Mrs ANN SMITH, c/o Mrs Burrell, 91 Lullingstone Crescent, St Paul's Cray, Orpington, Kent.
Miss BEATRICE TEMPLE, 9 St Anne's Crescent, Lewes, Sussex.
Miss HILDA MAY TURNER, 14 Linden Drive, Prenton, Birkenhead, Cheshire.
THOMAS FREDERICK WALKER, 'Zanesville', 111 Hollins Spring Avenue, Dronfield, Sheffield S18 6RP.
Miss SYLVIA WALL, 62 Salutation Road, Darlington, Co. Durham.
JOHN ROBSON WRIGHTSON, 'Greenside', Cherry Green, Broxted, Dunmow, Essex.

850th Meeting, 16 November 1968

C. AUSTIN BARKER, M.BA., C.F.A., 2 Hickory Drive, Rye, New York, U.S.A.
BRITISH SUB-AQUA CLUB, 120 (Special) Branch (23471418 Sgt Smith, B. W.), c/o Command Pay Office, Dhekelia, B.F.P.O. 53.
DUNDEE MUSEUM, c/o James Blair, Department of Natural History, Dundee.
Mrs MARY EDWARDS, Kingsmill, Castlemartin, Pembroke.
Miss SONIA A. FAWCETT, 'Toorak', Arkley Lane, Arkley, Barnet, Herts.
STEPHEN, C. FENWICK, 83 Rosedene Gardens, Gants Hill, Ilford, Essex.
ROY CLIFFORD GEARY, 72 London Road, Dunstable, Beds.

J. J. D. Greenwood, B.A., Zoology Department, The University, Dundee.
D. R. B. Harrison, 6 Westbank Road, Birkenhead, Cheshire.
T. J. Holtham, The Shell Shop, Bridge House, Hayle, Cornwall.
F. E. B. Johnson, The Bird Gardens, Stagsden, Bedford.
Robert Lee, 'The Beeches', Grange Road, Uckfield, Sussex.
Ralph H. Lowe, B.A., 4 Claremont Road, Roker, Sunderland, Co. Durham.
Mrs Judith Napper, Bona Vista, Cadsden, Princes Risborough, Aylesbury, Bucks.
Ritchard Read, 43 Holly Terrace, Hensingham, Whitehaven, Cumberland.
Anthony W. Round, 35 Nonsuch Court Avenue, Ewell, Epsom, Surrey.
Basil C. Rylatt, 229 Charlbury Road, Nottingham NG8 1NF.
Mrs L. Rylatt, 229 Charlbury Road, Nottingham NG8 1NF.
Timothy Schroder, Milcote, Ascot, Berks.
Danny Southey, 11 Brooklyn Avenue, Worthing, Sussex.
Edgar Charles Stevens, 14 Wey Gates Drive, Hale Barns, Altrincham, Cheshire.
Mrs E. C. Stevens, 14 Wey Gates Drive, Hale Barns, Altrincham, Cheshire.
Zee I. Vintola, P.O. Box 550, Cebu City, Philippines. 80201.
Miss Sylvia Stella Whitaker, 'Casa Nostra', Blackthorn Road, Launton, Bicester, Oxon.

851st Meeting, 14 December 1968

Mrs Gertrude Herbert, 133 Fotheringay Road, Pollockshields, Glasgow S.1.
Mrs Nancy Prior, Radnor Hotel, Green Point, Cape Province, South Africa.

MEMBERS DECEASED

Warren, R. Dawson, F.R.S.E., F.S.A.
Douglas Keely Kevan, F.R.C.A., F.R.S.E.

INDEX TO VOLUME 26

Acanthinula aculeata, vcr 289
A. lamellata, vcr 210, 346
Acanthochitona communis, new to Ireland 210
Accounts 206, 284, 340
Acicula fusca, vcr 345
Aden, *Mauritia mauritiana* 66
Agriolimax agrestis, habitat and anatomy 189
A. agrestis, vcr 288, 346
A. caruanae, vcr 209, 287, 288, 289, 344, 345, 346
A. laevis, vcr 77, 209
A. reticulatus, compared with *A. agrestis* 189
Ancylus fluviatilis, vcr 345
Annual Reports 76, 208, 286, 343
Anodonta anatina, vcr 77, 209, 345
A. complanata, vcr 288
A. cygnea, extrapallial cavity inhabited by an insect larva 380
A. cygnea, vcr 209
Anomiacea, taxonomy of British 107
Aplysia depilans, in north Devon 348
Arcacea, taxonomy of British 101
Arcticacea, taxonomy of British 238
Arianta arbustorum, on blown sand 47
Arion ater rufus, new to Ireland 290
A. ater rufus, vcr 77, 209, 289, 347
A. lusitanicus, vcr 77, 209, 288, 344, 345, 346
A. rufus, see as *A. ater rufus*
A. subfuscus, vcr 209, 288, 345, 346
Aspatharia bourguignati, comments on Kenyan records 73
Astartacea, taxonomy of British 248
Azeca goodalli, vcr 288

Balea perversa, vcr 210
Barnacle, G. A. S. Note on a streptaxid from Seychelles, *Imperturbatia levieuxi* (Nevill & Nevill) 386
Beedham, G. E. The extrapallial cavity in *Anodonta cygnea* (L.) inhabited by an insect larva 380
Bidder, A. M. Review 203
Biggs, H. E. J. A new species of *Littorina* from Eilat, Israel, and notes on its affinities with *Littorina novaezelandiae* Reeve 137
—— & Wilkinson, C. Marine Mollusca from Malta 52
Bithynia tentaculata, vcr 77
Blair, D. P., obituary 421
Block, M. R. Epiphragms: some observations 388
—— Some observations on *Halolimnohelix iredalei* Connolly 219
Blok, A. Reviews 281, 423
Borneo, new species of *Hydrocena* 39
Boss, K. J. Review 336
Bowden, J. Review 205
—— & Heppell, D. Pulteney's 'Dorset Catalogues', with special reference to the Mollusca 321
—— —— Revised list of British Mollusca. 1. Introduction; Nuculacea—Ostreacea 99
—— —— —— 2. Unionacea—Cardiacea 237
Bruggen, A. C. van. An introduction to the pulmonate family Streptaxidae 181
—— *Physa acuta*, an introduced species new to South Africa 49
Buccinum hepaticum, authorship 325
Burrowing mechanism of bivalves 294
Butcher, N. E. Obituary: H. L. Hawkins 418

Cain, A. J. Undescribed polymorphisms in two British snails 410
Cameroon, *Pisidium pirothi* 225
Cardiacea, taxonomy of British 248
Carychium minimum, vcr 210, 289, 347
C. tridentatum, vcr 77, 210, 289, 347
Catalogues of the Birds, Shells, and some of the more rare Plants, of Dorsetshire, validity of publication 321
Cecilioides acicula, vcr 77, 210, 345
Cenodagreutes aethus, *C. coccyginus*, additions to British list 348
Census, marine 78, 210, 290, 348
—— non-marine 77, 209, 287, 344
—— —— history 152
Cepaea nemoralis, morphs 125

Cerastoderma glaucum, new to Scotland . 268
CERNOHORSKY, W. O. The mitrid genera and species established by P. F. Röding in the 'Museum Boltenianum' 89
—— Radulae for four species of Mitridae 15
—— The species of Mitridae established by J. F. Gmelin in the 'Systema Naturae' of 1791 161
—— The species of Mitridae established by H. F. Link in the Rostock Catalogue 215
Chad, *Pisidium pirothi* 225
Chicoreus consuelae, synonymy . . 303
Chironomid larva in extrapallial cavity of *Anodonta cygnea* 380
CLARKE, B. Studies on the Partulae of Moorea [Abstract] 295
Clausilia bidentata, vcr 346
C. dubia, vcr 346
Cochlicella acuta, distribution of dark form 51
C. acuta, vcr 210
Cochlicopa lubrica, vcr . . 210, 289, 347
C. lubricella, vcr 77, 78, 210, 289, 347
Cochlodesma praetenue, authorship . . 324
Columella edentula, vcr 346
Cook, Capt. J., molluscs collected on his voyages 372
COOK, L. M. Notes on two colonies of *Cepaea nemoralis* (L.) polymorphic for white lip 125
Cornwall, *Theba pisana* in 19
Cultivation of *Pinctada margaritifera* . 26
Cyamiacea, taxonomy of British . . 247
Cypraea arctica, authorship 325
C. barclayi, description of type . . 310
C. barclayi, list of known specimens . 310
C. broderipii, list of known specimens . 311
C. broderipii, specimens in Saul collection 311
C. castanea, description of type . . 311
C. guttata, specimens in Saul collection . 311
C. marginalis, distribution in E. Africa . 229
C. marginalis, regional variation . . 229
C. marginalis pseudocellata, radula . . 235
C. mauritiana, see as *Mauritia mauritiana*
C. modesta, description of type . . 312
C. nivosa, specimens in Saul collection . 312
C. saulae, description of type . . 312
C. spurca, see as *Erosaria spurca*
C. trizonata, description of type . . 313
C. valentia, list of known specimens . 313
C. valentia, specimen in Saul collection . 313
C. venusta, description of type . . 313

DANCE, S. P. The Cook Voyages and Conchology 354
—— *Pisidium* collected by the 1924 Mount Everest expedition, with descriptions of two new species . 175
—— Reviews . . . 202, 281, 337
DAVIS, D. S. & WHITE, W. R. Molluscs from a power station culvert . 33
DEARING, E. Obituary: J. J. Lumb . 201
Distribution mapping, British non-marine 152
Dorset Catalogues (Pulteney), validity of publication 321
Dreissenacea, taxonomy of British . 238

EARLE, P. K. Review 146
East Africa, *Physa* 417
Ecological niches of molluscs . . 293
Editorial 1
ELLIS, A. E. *Agriolimax agrestis* (L.): some observations . . . 189
Ena montana, vcr 345
E. obscura, vcr 346
Ensis minor, new to Ireland . . . 210
E. phaxoides, new to Ireland . . 210
Epiphragms, structure and function . 388
Erd- und Süsswasser-Gasteropoden, dates of publication 84
Erosaria spurca, statistics 305
Everest expedition 1924, *Pisidium* . 175

Fowler, T. G. W., list of publications . 333
—— obituary 333

Gabriel, C. J., obituary 75
Galeommatacea, taxonomy of British . 245
GEORGE, T. N. Review 205
Glossacea, taxonomy of British . . 238
Gmelin, J. F., Mitridae 161

Halolimnohelix iredalei, biology . . 219
Hartmann, J. D. W.: *Erd- und Süss-*

wasser-Gasteropoden, dates of publication 84
Hawkins, H. L., obituary 418
Helicella caperata, vcr 288, 345, 346
H. elegans, vcr 345
H. gigaxi, vcr 345
H. itala, vcr 209
H. virgata, vcr 346
Helix aspersa, inheritance of scalariformity 329
H. aspersa, polymorphism of shell colour 413
H. aspersa, vcr 289
H. nemoralis, fossil, comments on Orkney record 135
H. nemoralis, see also as *Cepaea nemoralis*
Heppell, D. The dates of publication of J. D. W. Hartmann's *Erd- und Süsswasser-Gasteropoden* 84
—— John Gwyn Jeffreys [Abstract] 295
—— Obituary: C. J. Gabriel 75
—— Reviews 74, 278, 282, 335, 338
—— see Bowden, J.
—— & Waterson, A. R. Review 283
Hydrobia neglecta, vcr 77, 289
H. ulvae, vcr 77, 289, 346
H. ventrosa, vcr 346
**Hydrocena saulae* n. sp. 40
**H. scalinella* n. sp. 39
Hygromia hispida, vcr 288, 346
H. liberta, vcr 288, 345
H. striolata, vcr 77, 289, 345, 346
H. subrufescens, vcr 210, 288

Imbricaria punctata, radula 18
Imperturbatia levieuxi, from Seychelles 386
Ireland, distribution of dark *Cochlicella* 51
Islay, *Arianta arbustorum* 47
Israel, new species of *Littorina* 137

Jeffreys, J. G., biographical note 295
Joint Meeting with Malacological Society, report 293
Journal of Conchology, history 1
Jutting, W. S. S. van Bentham. Two new species of *Hydrocena* (Neritacea) from Sabah, Borneo 39

Kay, E. A. The Saul cowry collection 309
Kellia subtrigona, status 264
Kerney, M. P. Distribution mapping of land and freshwater Mollusca in the British Isles: a brief history and future prospects 152
—— Snails and Man in Britain 3
Kevan, D. K., conchological publications 420
—— obituary 419
Kuiper, J. G. J. On *Pisidium pirothi* Jickeli from Lake Chad 225
—— The status of *Pisidium hibernicum* Westerlund 42

Lamellaria latens, in Orkney 79
Lauria anglica, vcr 288, 289, 346
Leucophytia bidentata, vcr 210
Limax cinereoniger, vcr 77, 209, 344, 345
L. marginatus, vcr 288
L. tenellus, vcr 288
Link, H. F., Mitridae 215
Littorina novaezelandiae, selection of lectotype 138
**L. urieli* n. sp. 137
Liversidge, M. J. H. On the distribution of *Cypraea* (*Erosaria*) *marginalis* along the east coast of Africa 229
Lucinacea, taxonomy of British 244
Lumb, J. H., obituary 201
Lymnaea auricularia, vcr 210, 345
L. stagnalis, vcr 77
L. truncatula, vcr 77

McMillan, N. F. *Arianta arbustorum* (L.) living with *Helix nemoralis* L. on blown sand 47
—— Conchological publications by Robert Rendall 274
—— Kennard's record of fossil *Helix nemoralis* in Orkney 135
—— *Margaritifera margaritifera* (L.) in hard water in Scotland 69
—— Obituary: D. P. Blair 421
—— Obituary: T. G. W. Fowler 333
—— Obituary: R. Rendall 273
—— see Stelfox, A. W.
Malacological Society of London, joint meeting with 293
Malta, marine Mollusca 52
Man, effects of on snails 3

Marconia, type-species 71
Margaritifera margaritifera in hard water in Scotland 69
Mauritia mauritiana at Aden 66
Milax budapestensis, rearing and behaviour in soil 141
M. budapestensis, vcr 77, 209, 287, 288, 289, 345, 346
M. gagates, vcr 288, 346
M. sowerbyi, vcr 288, 344, 345, 346
Mitra chrysalis, radula 16
Mitridae, of Gmelin 161
—— of Link 215
—— of Röding 89
—— radulae 15
Monacha cantiana, polymorphism of mantle pigmentation 410
M. cantiana, vcr 344
M. granulata, vcr 210
Morton, J. Niches and habitats among the molluscs [Abstract] 293
Mother-of-pearl cultivation 26
Murex trigonulus, nomenclature 300
Museum Boltenianum, mitrid genera and species 89
Mya praetenuis, authorship 324
M. pubescens, authorship 324
Mytilacea, taxonomy of British 102

Nassarius hepaticus, authorship 325
Neritacea, new species of *Hydrocena* 39
Nuculacea and Nuculanacea, taxonomy of British 100

Obituaries:
  Blair, D. P. 421
  Fowler, T. G. W. 333
  Gabriel, C. J. 75
  Hawkins, H. L. 418
  Kevan, D. K. 419
  Lumb, J. H. 201
  Quick, H. E. 275
  Rendall, R. 273
  Turner, R. 334
Officers and Council 83, 151, 299
Orkney, comment on record of fossil *Helix nemoralis* 135
—— *Margaritifera* 69
Ostreacea, taxonomy of British 108
Oxychilus draparnaudi, vcr 288, 344, 345, 346
O. helveticus, vcr 288, 345

Partula in French Polynesia 295
Pectinacea, taxonomy of British 105
Pettitt, C. W. Obituary: R. Turner 334
—— Reviews 280, 339
Physa acuta in E. Africa 417
P. acuta in S. Africa 49
P. acuta in Uganda 50
P. acuta, vcr 345
P. fontinalis, vcr 289, 346
Phytia myosotis, vcr 77, 288, 289, 345
Pinctada margaritifera, cultivation 26
Pinnacea, taxonomy of British 104
Pisidium of Everest Expedition 1924 175
P. casertanum, vcr 77, 209, 345
P. conventus, vcr 346
**P. ellisi* n. sp. 178
P. ferrugineum, status 42
P. henslowanum, vcr 209
P. hibernicum, status 42
P. hibernicum, vcr 288, 346
**P. kuiperi* n. sp. 176
P. lilljeborgii, ver 288, 346
P. milium, vcr 209, 288
P. moitessierianum, vcr 209, 288, 289, 345
P. nitidum, vcr 345
P. obtusale, vcr 209, 288, 345
P. personatum, vcr 77, 209, 288, 345
P. pirothi, in Lake Chad 225
P. pulchellum, vcr 210, 288, 345, 346
P. stewarti, in Tibet 175
P. subtruncatum, vcr 209
P. supinum, vcr 288, 345
P. tenuilineatum, vcr 288
P. vincentianum, see as *P. stewarti*
Planorbarius corneus, vcr 209, 288
Planorbis albus, vcr 210, 288, 346
P. carinatus, vcr 210
P. contortus, vcr 77, 287
P. crista, vcr 345, 346
P. laevis, vcr 288, 289
P. vortex, vcr 78
P. vorticulus, vcr 345
Polymorphism in *Cepaea nemoralis* 125
—— of mantle pigmentation in *Monacha cantiana* 410
—— of shell colour in *Helix aspersa* 413

Pomatias elegans, vcr 77
Potamopyrgus jenkinsi, vcr 77, 289, 345, 346
Potidoma, status 266
Proceedings 76, 147, 208, 286, 342, 425
Pseudamnicola confusa, vcr 288, 345
Pteriacea, taxonomy of British 104
Pterynotus and *Pteronotus*, nomenclature 304
P. annandalei, synonymy 302
P. triqueter, synonymy 302
Pulteney, R., discussion of his molluscan names 323
—— Dorset Catalogues 321
Punctum pygmaeum, vcr 345
Pupilla muscorum, vcr. 77, 346
Pusula, statistics 131
Pycnodonte cochlear, new to Britain 122, 210
Pyramidula rupestris, vcr 210

Quick, H. E., list of publications 276
—— obituary 275

Recorder's report, see Census
Reed, W. Cultivation of the Black-lip Pearl Oyster *Pinctada margaritifera* (L.) 26
Rees, W. J. Review 279
Rendall, R., conchological publications 274
—— obituary 273
Retinella nitidula, vcr 289, 346
R. radiatula, vcr 345
Reviews 68, 72, 74, 140, 146, 202, 278, 335, 422
Röding, P. F., mitrid genera and species 89
Rostock Catalogue (Link), Mitridae 215

Sabah, new species of *Hydrocena* 39
Saul, J., cowry collection 309
Scalariformity, inheritance in *Helix aspersa* 329
Scase, R. P. Volutidae [Abstract] 296
Schilder, F. A. *Mauritia mauritiana* (L.) at Aden 66
—— & Schilder, M. Statistics in north-west American *Pusula* Jousseaume (Triviidae) 131
—— —— Statistics of a population of *Erosaria spurca* (L.) 305
Schilder, M., see Schilder, F. A.
Scotland, *Margaritifera* in hard water 69
Segmentina complanata, vcr 287
Semele proficua, authorship 324
Seychelles, *Imperturbatia levieuxi* 386
Smith, S. M. Review 422
Solen marginatus, authorship 324
South Africa, introduction of *Physa acuta* 49
Sphaeriacea, taxonomy of British 239
Stelfox, A. W. On the inheritance of scalariformity in *Helix aspersa* 329
—— & McMillan, N. F. The distribution in Ireland of very dark forms of *Cochlicella acuta* (Müller) 51
Stephenson, J. W. Notes on the rearing and behaviour in soil of *Milax budapestensis* (Hazay) 141
Stratton, L. W. List of publications by H. E. Quick 276
—— Obituary: H. E. Quick 275
—— Review 140
Streptaxidae, general account 181
Strigatella litterata, radula 16
S. tristis, radula 16
Succinea pfeifferi, vcr 77, 288
S. putris, vcr 288
Sussex, molluscs from Brighton power station 33
Systema Naturae (Gmelin), Mitridae 161

Tellina fausta, authorship 324
T. proficua, authorship 324
T. squalida, authorship 324
Testacella haliotidea, vcr 209
Theba pisana, ecology of 22
T. pisana, in Cornwall 19
T. pisana, vcr 77
Thracia pubescens, authorship 324
Thyasira equalis, new to Britain 210, 263
T. gouldii, ? British 263
T. subtrigona, status 264
Tonicella rubra, Cornish record rejected 79
Trichia, date and type-species 85n
Trivia arctica, authorship 325
Trueman, E. R. The mechanism of burrowing in Bivalvia [Abstract] 294
Truncatellina cylindrica, vcr 345
Turk, S. M. The rediscovery of *Theba pisana* (Müller) in Cornwall 19
—— Reviews 202, 424

Turner, R., obituary 334

Uganda, introduction of *Physa acuta* . 50
**Unio castelli* n. sp. 198
Unionacea, taxonomy of British . . 237
Unionidae, British Lower Tertiary . 197

Valionia costata, vcr 210
V. excentrica, vcr . . . 78, 210, 288, 346
V. pulchella, vcr . . . 287, 288, 345
Valvata cristata, vcr . . . 288, 345
V. piscinalis, vcr 210
Veneracea, taxonomy of British . . 240
Verdcourt, B. Comments on T. E. Crowley's paper on *Aspatharia bourguignati* (Bourguignat) . . 73
—— *Physa* in East Africa . . . 417
—— Review 68
—— The type-species of *Marconia* Bourguignat (Streptaxidae): a correction 71
Vertigo antivertigo, vcr . . . 209, 345
V. lilljeborgi, vcr 77, 289
V. moulinsiana, vcr 78
V. pusilla, vcr . . . 288, 289, 345
V. pygmaea, vcr 77
V. substriata, vcr 288
Vice-County records, see Census
Vitrea contracta, vcr . . 78, 210, 289, 347
V. crystallina, vcr . . 78, 210, 289, 347
V. diaphana, vcr 346
V. diaphana, see also as *V. subrimata*
V. subrimata, new to Britain . . 289
V. subrimata, vcr 288
Vitrina major, vcr . . . 209, 344, 345
V. pyrenaica, vcr 346
Viviparus viviparus, vcr 345
Vokes, E. H. On the identity of *Murex trigonulus* of authors 300
Volutidae 296

Waterson, A. R. Conchological publications of D. K. Kevan . . . 420
—— Obituary: D. K. Kevan . . . 419
—— see Heppell, D.
White, W. R., see Davis, D. S.
Wilkinson, C., see Biggs, H. E. J.
Woodward, F. R. Monograph of the British Lower Tertiary Unionidae: corrections and additions . . . 197

Yonge, C. M. Review 72

Zonitoides excavatus, vcr 210, 288, 289, 345, 346
Z. nitidus, vcr 288

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